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A STUDY OF IMPROVED HIGH-SPEED PUBLIC TRANSPORTATION BETWEEN LOGAN INTERNATIONAL AIRPORT AND DOWNTOWN BOSTON

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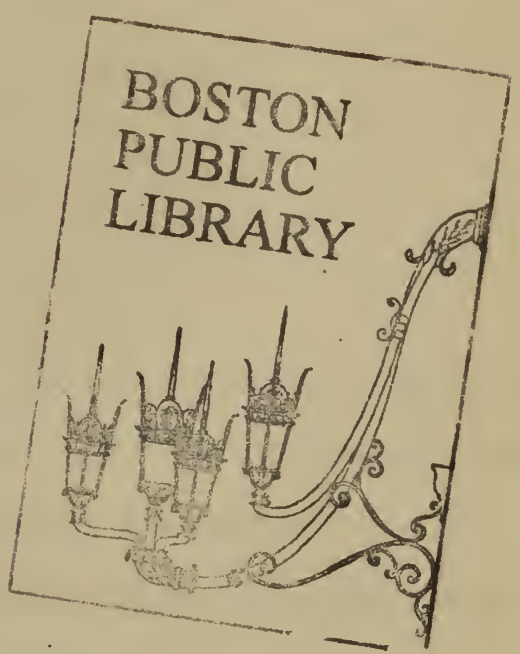
A STUDY OF IMPROVED HIGH-SPEED PUBLIC TRANSPORTATION

Between
Logan International Airport
and
Downtown Boston

A Joint Study by the
Massachusetts Bay
Transportation Authority

and the
Massachusetts Port Authority

December 18, 1968



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RECOMMENDATIONS

This study has pointed up the need for more complete data on which to plan for improved ground access between Logan International Airport and Downtown Boston. It is recommended:

1. That an origin and destination study be made of ground transportation trips between the Airport and all sections of the Downtown and of the Metropolitan Boston Air Service Area, including an analysis of the existing use of MBTA services and the attitudes of potential riders toward future improvements and use of public ground transportation services. This study could be undertaken in accordance with an interagency agreement by and between the agencies concerned with improved access to the airport: that is, the Massachusetts Port Authority, the Massachusetts Bay Transportation Authority, the Massachusetts Turnpike Authority and the Massachusetts Department of Public Works.

2. That, if the origin and destination survey indicates sufficient potential use of public transportation for airport access, further studies be conducted of the possibilities for improved access between the airport and downtown, including South Station, with connections to MBTA rail transit lines and the proposed high speed rail line between Boston and Washington. It is understood that the Federal Department of Transportation may be interested in participating in such studies.

SUMMARY OF FINDINGS

In recent years, air passenger volumes at Boston-Logan International Airport have increased approximately 14 percent a year. It has been a continuing concern of the Massachusetts Port Authority, State and Federal government highway planning agencies, and the Massachusetts Bay Transportation Authority that there be coordinated planning to accommodate the increasing demands for ground transportation to and from the Airport.

Pursuant to the June 12, 1968 Resolve of the Commonwealth of Massachusetts House of Representatives, the Massachusetts Port Authority and the Massachusetts Bay Transportation Authority have jointly investigated the problem of improving high-speed transportation between Logan Airport and Downtown Boston. The findings are as follows:

1. Airport Growth Projections

The Airport will more than double its passenger volume by 1980. Approximately eight million passengers will be served in 1968, and the figure will climb to 19,600,000 passengers by 1980. Non-flying visitors to the Airport are almost as numerous as air passengers. A survey indicated that each passenger generated 0.8 visitors, not including employees of the airlines or airport facilities. The total number of Airport users is more than twice the passenger count, as indicated by the following chart:

	1968	1980
Enplaned Passengers	(4,000,000)	(9,800,000)
Total Passengers	8,000,000	19,600,000
Visitors to Airport (0.8 visitors per passenger)	6,400,000	14,240,000
Sub Total:	14,400,000	33,840,000
Airport Employees	7,500*	18,369**
Total:	14,407,500	33,858,369

*Approximate existing number

**Calculated from existing ratio of employees per passenger.

2. Airport Access Characteristics

An April, 1968 survey of passengers to and from the Airport indicated that private vehicles are predominant .

Private automobile	64%
Rent-a-car	6%
Taxi	25%
Limousine and Bus	5%
	100%

In 1967, 1,600MBTA customers entered trains each day at the Airport station. A 1967 survey of the connecting bus service indicated that 52.7% of this total were air passengers; 23.3% were visitors and 24% were employed at the Airport. This indicates that the rapid transit is used by approximately 4-5% of the air passengers.

3. Vehicular Access to Airport

At peak hour 2,200 vehicles now enter the access roads to the Airport. Projected peak-hour vehicular volumes will surpass the capacity of the three-lane access road by 1980. If the road is widened to six lanes, the capacity will be sufficient to handle the estimated traffic volumes. The construction of the Third Harbor Crossing will generate additional volumes to be added to the existing traffic from the Sumner-Callahan Tunnels and the McClellan Highway. All highway access will be funnelled into the access roadways which presently lead into the Airport.

4. Airport Parking

Existing passenger and visitor parking facilities at the Airport include 5,800 spaces, of which 3,100 are located in the new three-level parking garage. Parking demand for passengers will be approximately 13,700 spaces by 1980, if present mode characteristics continue. With five-level parking garages constructed on presently available land, 14,600 spaces could be provided. Airport employees presently park in spaces near tenant facilities, but they will require 4,000 parking spaces by 1980, if the automobile continues to predominate, and this may necessitate relocation of employee parking.

5. Physical Constraints

The physical layout of the Airport makes difficult, both the provision of more than six inbound lanes for access roads, and the goal of parking for all persons desiring future spaces near destinations within the Airport area. The development of the Airport may preempt certain existing employee parking lots and force construction of new lots more remote from Airport employment centers. Passenger parking areas more remote from the air terminal buildings may need to be developed, with shuttle service between parking lots and Airport buildings.

6. Profiles of Air Passengers

Studies of current air travellers show certain trends which are

useful in predicting access patterns to and from airports. A substantial relationship exists between family income and the likelihood of travelling by plane. According to the recent study of air transportation potential and facility requirements for the Metropolitan Boston air service area, members of families having an income of $15,000 or more are ten times as likely to take an air trip as families with annual incomes of $5,000 to $10,000. Estimates provided by the Metropolitan Area Planning Council indicate that by 1990, about three-quarters of the families in the area will have incomes of over $10,000 as opposed to 30 percent of the present Boston area households which have incomes of $10,000 or more. This means a very substantial increase in the number of families in the groups that are primary users of air transportation.

Another important factor is the growing recognition that the home is the primary point of local origin and destination. The findings of a recent study made for the Los Angeles Department of Airports indicated that eighty percent (80%) of the local air passengers have their home as their local point of origination, eighty-three percent (83%) have their home as their local point of destination, while seventy-one percent (71%) of these local air passengers both originate and terminate their air trips from their homes.

For purposes of this study the most important aspects of air passenger travel patterns is the tendency to use individual vehicles (private or rented autos and taxis) for access to and from the Airport. The principal advantage of individual vehicles is the portal-to-portal access such vehicles can provide to the dispersed origins and destinations of air passengers throughout the region. There is little evidence to suggest that a high percentage of locally-originating air passengers desire to travel between downtown and the airport. Non-locally originating passengers, by contrast, may be the largest single groups desiring to travel between Downtown Boston and the Airport.

7. Diversion of Additional Air Passengers to Rapid Transit

The combined influence of automobile preference for Airport access and the dispersion of local origins or destinations may well limit the number of potential rapid transit riders to the Airport. The number of transfers - from bus to transit and between transit lines - is an inconvenience to air passengers, particularly for those with hand luggage. The existing limousine and taxi service to downtown is more convenient than rapid transit and taxis are used much more extensively than transit despite the higher fare.

Future projections of ground access to the Airport indicate a peak hour travel demand which may limit the effectiveness of private or individual vehicles for Airport access. When sufficient congestion occurs

existing rapid transit services may be more extensively utilized by local residents seeking access to the Airport. Air travellers from outside the Boston area using Logan Airport may well have downtown destinations, but there is no evidence that these travellers use public mass transportation to reach downtown. Available information suggests that unfamilarity with the local rapid transit system (and expense account travelling) lowers the likelihood of rapid transit use by strangers to Boston.

8. Averting Ground Transportation Congestion at Logan Airport:

A. Diversion of Air Traffic to New Facilities

The projected growth of ground traffic at Logan Airport indicates a developing congestion. Many physical improvements will be effected in the near future to the Airport's ground traffic handling capacities.

A recent study of the air transportation potential and facility requirements in the Metropolitan Boston Air Service Area has proposed a new Southwest Airport which would be capable of handling larger volumes of air passengers. This study is being reviewed by a committee which will have its recommendations sometime next year.

The second major proposal is the Northeast Corridor Study, a high-speed ground transportation project being carried forward by the Federal government. This project could divert substantial traffic from the airlines, if restrictions on airport access in New York preclude an expansion of flights of a relatively short-distance, such as the Boston-New York run. Thirty-five to forty percent of all air traffic at Logan is destined for New York. A transfer of significant portions of this volume to another mode of travel would have a pronounced effect on reducing ground traffic at Logan Airport.

9. Averting Ground Transportation Congestion at Logan Airport:

B. Improved Facilities for Passenger Access at Logan

Four basic possibilities for improving high-speed transportation to Logan Airport have been suggested: (a) a new rapid transit line between downtown and the Airport; (b) a new spur of the existing rapid transit line; (c) new forms of shuttle service at the Airport; and (d) a combination bus shuttle express bus service.

(a) A New Rapid Transit Line A possible alternative solution to improved Airport access via rapid transit is a new line and station at the air terminal buildings. This new line would involve construction of a rapid transit tunnel under the Harbor, connecting Logan Airport directly to the new transportation complex at South Station. This tunnel might be an element of the Mass. Turnpike Authority's proposed Third Harbor Crossing, or it could be constructed separately. Its major advantages include:

(1) Connection of the Riverside Line to the Blue Line with downtown stations at the Airport, South Station and Back Bay.

(2) In the Back Bay, a joint station with the Orange Line extension could be possible. Study of the proposal might include the feasibility of using Orange Line equipment on the new extension and construction of an interconnection of trackage between Back Bay and South Cove to enable Orange Line trains to operate to the Airport and the North Shore.

(3) A station on the new line at South Station would enable connections to the proposed High-Speed rail service to New York and to the Trailways-Greyhound bus terminal planned as part of this complex. If a new stadium is constructed in the area of South Station, access to it would be possible via pedestrian connections (moving belt, etc. through the South Station complex and parking garage).

(4) A new use for the existing East Boston tunnel would have to be found. One possibility in a new Downtown to Airport shuttle service using the new technology of individually-actuated vehicles. Another possibility might be for movement of air cargo, a rapidly growing function of the Airport.

(5) This alternative is undoubtedly relatively expensive involving a length of tunnels from the north side of Logan Airport to South Station. If further study of the proposal is desired, it should proceed immediately, in order to include joint feasibility studies with the Mass. Turnpike Authority.

(b) A Spur of Existing Rapid Transit As a portion of the MBTA and Central Area Systems Study (CASS), a consultant is examining the feasibility of a spur of the existing rapid transit line into the center of the airport. The proposed development of the airport with dispersed terminals may result in some difficulties of direct pedestrian access between planes and trains. A loop of rail with more than one rapid transit station may be necessary to effectively serve the future airport rapid transit riders.

(c) Improved Shuttle Service Increased surface street congestion may decrease the attractiveness of the existing shuttle bus for movement not only for rapid transit riders but also for riders transferring between air terminal buildings. Several alternatives for improving this service have been suggested. All proposals call for a new mode of movement on an aerial right-of-way, free from grade intersections and using a type of vehicle which can provide frequent service from multiple stations within the airport. The connection between terminal buildings and the rapid transit station can be extended to include the remote parking facilities which the Mass. Port Authority foresees for the future passengers and for its employees.

(d) Combination Bus Shuttle Express Bus Service The possibility of a third harbor crossing, now being considered by the Massachusetts Turnpike Authority, affords an additional alternative method of serving traffic between the airport and downtown Boston. The proposed tunnel would extend from the vicinity of South Station to the McClellan Highway at the entrance to Logan Airport. The construction of the proposed Trade and Transportation Center at South Station by the Massachusetts Port Authority would include extensive facilities for bus terminal operations, in addition to connections with the proposed high speed ground transportation service to New York and Washington and with the exisfing Massachusetts Bay Transportation station in Summer Street. The proposed terminal will handle inter-regional buses from throughout New England and may well include commuter buses from the Boston Metropolitan region.

An express bus service could operate from the Trade and Transportation Center at South Station via the proposed third harbor tunnel to Logan Airport, thereby giving direct access to many air passengers who might otherwise choose to drive personal vehicles to the airport. The express service could be combined with the existing Massachusetts Bay Transportation Authority bus shuttle service at the airport to provide extensive distribution between air terminal buildings, parking areas and the existing Massachusetts Bay Transportation Authority airport rapid transit station. Pending construction of the third harbor tunnel, the combination of express bus and shuttle service could be operated by using the existing Sumner-Callahan tunnels and the Central Artery. When the third harbor tunnel is constructed, however, it would be desirable to reserve a lane in each direction for the exclusive use of such buses.

PART I - INTRODUCTION

I. 1. The Problem of Ground Access at Logan International Airport

In recent years, air passenger volumes at Boston-Logan International Airport have increased approximately 14 percent a year. It has been a continuing concern of the Massachusetts Port Authority, State and Federal government highway and transit planning agencies, and the Massachusetts Bay Transportation Authority that there be coordinated planning to accommodate the increasing demands for ground transportation to and from the Airport.

The Massachusetts Port Authority, almost from the beginning of its responsibility as airport operator in February 1959, began to expand the capacity of the roadway and parking system at the Airport. Surfaces were repaved, curbside parking controlled, taxi lines and taxi hold-areas organized, central parking area redesigned, and new parking lots established. Outside traffic specialists were employed by the Port Authority, beginning with Barton-Aschman Associates traffic study of 1962 and continuing through the current master plan for roadways and parking being completed by John C. Warnecke and Associates.

During this period, the Massachusetts Bay Transportation Authority has substantially improved public transportation to the Airport. After study, the Authority doubled the number of bus trips between the Airport MBTA station and the Logan Airport terminal buildings to gain the most effective use of existing equipment. This new service was inaugurated in 1965 and has provided the Airport one of the best public bus services in the country. Buses now operate between the Airport station and the terminal buildings with five minute intervals between trips. Rapid transit trains to downtown and to the north operate on a 10-minute headway.

From 1963 to 1968 a comprehensive planning project has been underway to examine transportation needs for the entire metropolitan area. This five-year study called Eastern Massachusetts Regional Planning Project (EMRPP) was conducted by the Massachusetts Department of Public Works and the Massachusetts Department of Commerce and Development with participation by the Massachusetts Bay Transportation Authority, the Metropolitan Area Planning Council, and the City of Boston. The study report, titled Recommended Highway and Transit Plan is about to be published and proposes a $1.5 Billion balanced development of highways and rapid transit for this area. This report's recommendations recognize the critical relationship of the growth of the downtown and the airport, and access between them.

I. 2. Legislative Resolve to Explore Airport Access Problems

The spiralling air traffic and the projected congestion of ground traffic seeking access to the Airport led to an early recognition that new forms of access should be explored. The present study developed from a

proposal of Representative Michael Paul Feeney in 1967 that the MBTA and the Port Authority study the possibilities of monorail transportation between areas of travel focus. Representative Feeney filed House 1939 providing for such study in the 1968 session of the Legislature as an amended proposal to an original petition. Chapter 90 of the Resolves of 1968, which provided for the present study, was enacted in the House of Representatives and in the Senate on June 12, 1968. It was signed by Governor John A. Volpe on June 19, 1968. (See Appendix A)

No funds were appropriated by the Legislature for the study. In the limited time available since the Resolve was created, the staffs of the Massachusetts Bay Transportation Authority and the Massachusetts Port Authority have cooperated to analyze public transportation between the Airport and downtown, to compare this system with similar systems, and to discuss with various staff and consultant transportation specialists the possibilities for improvements.

I. 3. Scope of Study

The principal purpose of this document is to report on the Massachusetts Port Authority and the Massachusetts Bay Transportation Authority staff activities which impinge on the possibility of improving public mass transportation services between downtown Boston and Logan International Airport. Information contained in the report has been compiled from past and current studies, and from agency files. It includes current concepts for improved airport-downtown access by public transportation in Boston and elsewhere, whether the concepts have been theoretically explored, or are being intensively studied. It illustrates that spiralling air traffic severely taxes ground support facilities in providing efficient and inexpensive access to and from the air terminal buildings at all major airports across the country. It concludes by pointing toward alternative solutions to the problem in terms of mass transportation facility alterations or additions. In brief, the contents of the report are outlined below.

The first section (Part II) of this report deals with projected developments in downtown Boston and the air travel demand which is generated by downtown business establishments. The second section (Part III) describes air travel characteristics at Logan International Airport, with particular emphasis on the proportion of air traffic between downtown and the airport. The third section (Part IV) examines ground traffic at the airport and reports on the use of mass transportation facilities. The fourth section (Part V) projects air traffic potential in relation to the limitations on ground access to the airport. The last section (Part VI) deals with the solutions which are currently being studied and which have been proposed to provide better mass transportation services to the Airport.

A lack of pertinent data became apparent during the course of collecting and organizing the various sections of the study. Furthermore, the validating and expanding of certain information has been left to future studies, including those recommended in the preface of the report.

PART II - PROJECTED DEVELOPMENT OF DOWNTOWN BOSTON AND LOGAN INTERNATIONAL AIRPORT

II.1. Downtown Boston

The phenomenal development of Downtown Boston is proceeding rapidly, adding office and retail space in the financial and retail trade districts as well as the Back Bay area. For purposes of this study, Downtown was defined as the area included within boundaries formed by Massachusetts Avenue, The Charles River, Boston Harbor, Fort Point Channel and the Southeast Expressway.

Within this area, there are several concentrations of intensive economic activity which are strongly related to the potential use of rapid transit and which may form the basis for much of the air travel demand which is generated by the Downtown area. These concentrations include the financial district, the retail core, Government Center and the Prudential Center. Each of these areas has physical evidence of change in recent years through the process of private and public renewal activities. Intensified use of the financial district has begun with the new State Street Bank Building and is now proceeding through construction of the new First National Bank Building. Several other new office towers are in planning stages. One retail area is witnessing the construction of a new building for Raymond's Department Store and preliminary street construction which will make possible the proposed Washington Street Shopper's Mall. Additional study of a proposed connection between South Station and the major department stores is proceeding with examination of pedestrian conveyances which would be constructed, through urban renewal efforts, at the second floor level of buildings along Summer Street. The development of Government Center has brought one of greatest single concentrations of new buildings to Downtown. In addition to city, state and federal office buildings, private buildings nearby include the nearly completed New England Merchants Bank Building, and the Boston Company Building and Three Center both of which are under construction at this time. Projected developments include completion of the Government Center Plaza, a new office tower at Beacon and Tremont Streets and the rehabilitation of the Fanuiel Hall area leading toward the Waterfront. The Prudential Center area of Back Bay is being expanded by the completion of the Center with new offices and shopping facilities. Peripheral development adjacent to Prudential Center has proceeded rapidly, principally in the form of a proliferation of additional shopping facilities. The

beginning of construction of the Christian Science Center will add significantly to the office and residential expansion of the area.

New centers of activity are emerging in Downtown as private and public efforts continue to revitalize the city's core. Perhaps the most impressive single project is the 60-story tower of the John Hancock Mutual Life Insurance Company at Copley Square. This development presages a new form of activity in the Copley Square area. The South Cove Urban Renewal Project includes new facilities for Tufts-New England Medical Center and Don Bosco High School, as well as significant alterations in the lower Tremont Street and Park Square areas. A major new form is proposed by the Massachusetts Port Authority at South Station, where the Authority plans to construct a $60 million trade and transportation center. This facility will include: a 500-room hotel; a terminal for a complete system of rail and other ground transportation vehicles; an office building for port-related businesses and agencies (including U. S. Customs and the MPA); a 5000-car parking garage; and a major trade mart.

II.2. Logan International Airport

The Massachusetts Port Authority has completed, under construction, or in the planning stage, about $250 million in improvements through 1972 to bring Logan to a level comparable to the best airports in the world. A major emphasis of this development has been directed toward development of new terminal facilities and related access and parking needs.

The nearly completed new Southwest Terminal building is being constructed by the Massachusetts Port Authority for lease to Eastern Airlines. Scheduled for completion in May 1969, the $16 million contemporary structure will serve conventional jets as well as the jumbo and supersonic aircraft. Four levels of parking will accommodate more than 1,000 cars.

The proposed South Terminal is being designed as the world's largest single unit air terminal with an ultimate capacity of eight million passengers per year. The terminal is specifically designed to accommodate both the 500 passenger aircraft as well as conventional jet aircraft. The design objective of the new terminal is to minimize passenger walking distance and expedite traffic flow by more closely relating the ground transportation vehicle to the aircraft. This will be accomplished by an extensive roadway system with curb space adjacent to aircraft parking positions. This approach is necessary to minimize restrictions in flow of passenger traffic with the advent of high density aircraft.

The $53 million, seven level structure will have 34 gate positions. The 1/4 mile long structure will house American, Allegheny, Mohawk and National Airlines, when completed in 1972.

The full Massachusetts Port Authority Airport program through 1972 is outlined below.

Phase I - landing areas

- Completion of $1.6 million in new high speed turnoffs at taxiways and runways in July 1968

- Extension of runway 15R-33L to 10,000 feet is under construction. To be completed in the summer of 1969 at a total cost of $5 million.

- Planning and construction of a portion of a two-way terminal peripheral taxiway system and expansion of south and northwest terminal aprons to be completed in October 1969 at a cost of $2.5 million

- Lighting of runway 15L-33R for night-time general aviation use in August 1968

Phase II - terminal area

- Completion of the $1.1 million second level addition to the International Terminal in September 1967

- Opening of the $5 million three-level parking garage, with direct access to all the terminal areas, in October 1967. The parking garage can hold 3,169 vehicles at one time. Combined with outdoor lots, a total of 5,560 parking spaces excluding short term metered parking, are available at Logan.

- Completion and opening of the initial phase of the two-level terminal roadway, at a cost of $5 million, in January 1968

- Additions to the Porter Street substation and heating/air conditioning plant were completed in October 1967 at a cost of $2.6 million

- Continued progress on the $7.2 million second level piers of the North Terminal, with a scheduled opening date in the fall of 1969

- Continued construction of the new $16 million Southwest Terminal complex, to be occupied by Eastern Airlines, now 75 percent complete and scheduled for opening in May of 1969

- Design of the new South Terminal complex, expected to cost about $53 million. Construction is due to start in 1968, with a target completion datein the fall of 1972.

- Design work started on a new International Terminal, expected to cost about $22 million

- Planning for a new baggage-handling network and "people mover" is in progress

Planned

- Expansion of the parking garage

- Construction of 9,200 foot runway 15L-33R

- Substantial expansion of airport roadway system

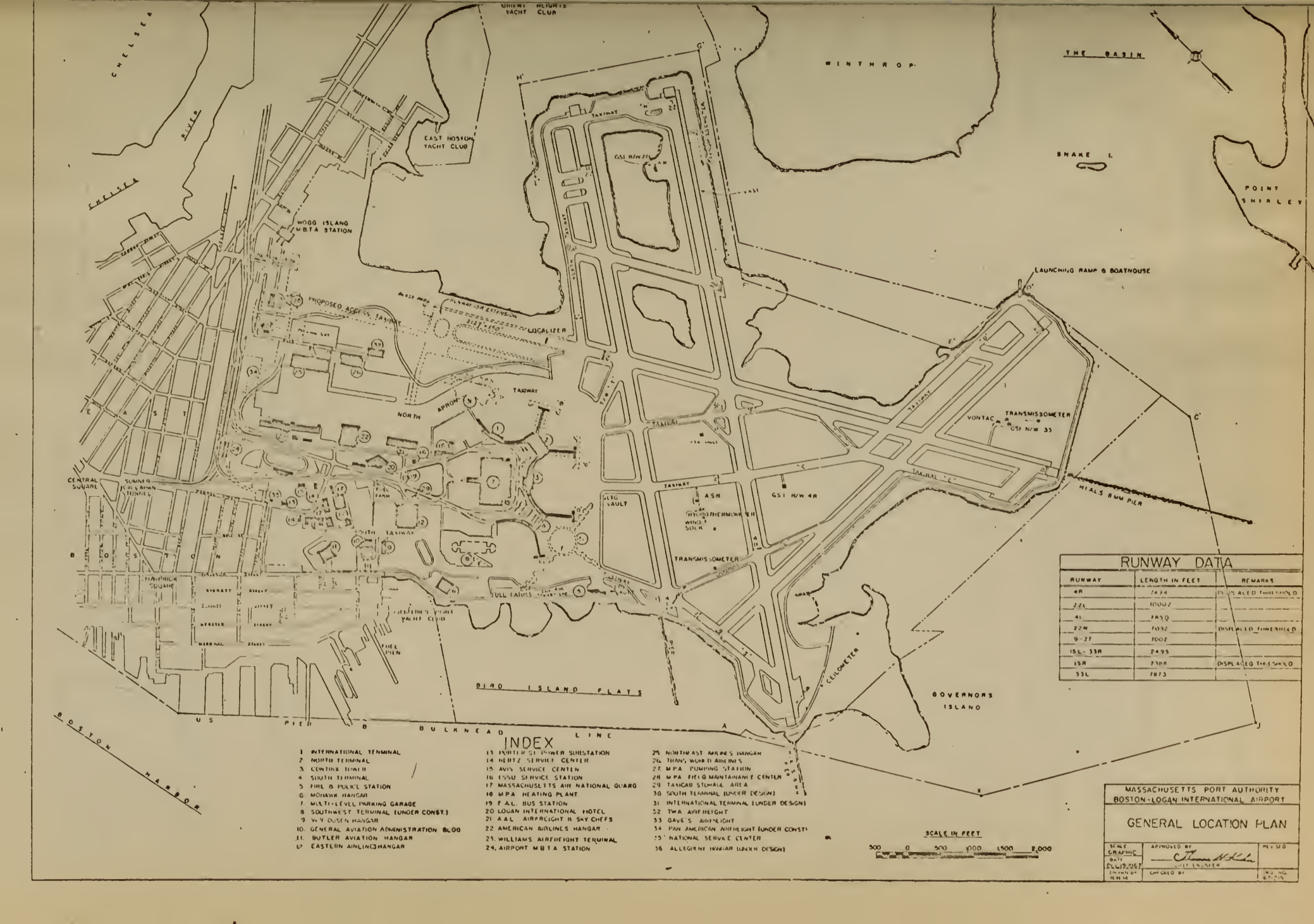
- Development of electronic equipment to improve utilization of runway 4R for instrument operations

Phase III - support area

- Construction progressing on a $3.5 million new hangar for Allegheny Airlines - scheduled for completion in the spring of 1970.

- The planning of new air cargo facilities and hangars in the Bird Island Flats area. Filling of this portion of Boston Harbor continued, with major drainage and dike work slated for 1969 at an anticipated cost of $7.2 million

- Acquisition by the MPA of the former Massachusetts Air National Guard area for future development, October 1968.



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36. ALLEGHENY HANGAR (UNDER DESIGN)

SCALE IN FEET
500 0 500 1000 1500 2,000

RUNWAY DATA

RUNWAY	LENGTH IN FEET	REMARKS
4R	7434	DISPLACED THRESHOLD
22L	10002	
4L	7830	
22R	7032	DISPLACED THRESHOLD
9-27	7002	
15L-33R	9495	
15R	7318R	DISPLACED THRESHOLD
33L	7873	

MASSACHUSETTS PORT AUTHORITY
BOSTON-LOGAN INTERNATIONAL AIRPORT

GENERAL LOCATION PLAN

SCALE GRAPHIC
DATE DEC 19, 1967
DRAWN BY M.H.H.
APPROVED BY
CHIEF ENGINEER
REVISED
CHECKED BY
NO. NO. 67-715

PART III - PROJECTED AIR TRAFFIC AT LOGAN INTERNATIONAL AIRPORT

III.1. Annual Enplaned Passengers

During fiscal 1968, four million enplaned air passengers or eight million total air travelers were accommodated at Logan Airport. Only ten years ago, in fiscal 1958, the total was less than two and one-half million. (See Table 2) The more than tripling of air travelers at Logan Airport in ten years indicates the magnitude of the growth factors involved in this study.

Another six million persons, who were neither air travelers or airport employees, visited the Airport during the past fiscal year.

Airport employees number approximately 8,000, including 7,000 persons who are employed by the airlines.

TABLE 2: AIR PASSENGERS AT LOGAN AIRPORT 1958-1968

Fiscal Year Ending June 30	Domestic Passengers	International Passengers	Total Passengers	Percent Increase
1958			2,386,241	
1959			2,590,628	
1960			2,932,231	13.2%
1961			2,919,602	-0.4
1962			3,457,339	18.4
1963			3,838,124	11.0
1964	4,300,392	278,480	4,578,872	19.3
1965	4,811,728	313,086	5,124,814	11.9
1966	5,572,123	396,825	5,968,948	16.5
1967	6,222,547	468,699	6,691,246	12.1
1968	7,745,920	577,566	8,323,486	24.3

Source: Massachusetts Port Authority

In five years the Port Authority estimates that the total will be approximately six and one-half million enplaned passengers or thirteen million total passengers.

With a growth rate of 14 percent a year, air travel forecasts can reach startling proportions. Table 3 shows the projections for air travel by the Federal Aviation Administration, United Airlines and Landrum and Brown (consultants for the study of Boston Metropolitan Air Service Facilities.) Two forecasts were made by Landrum and Brown for, respectively, Logan Airport as the only major airport for Boston, and with Logan and a "Southwest Airport" operating.

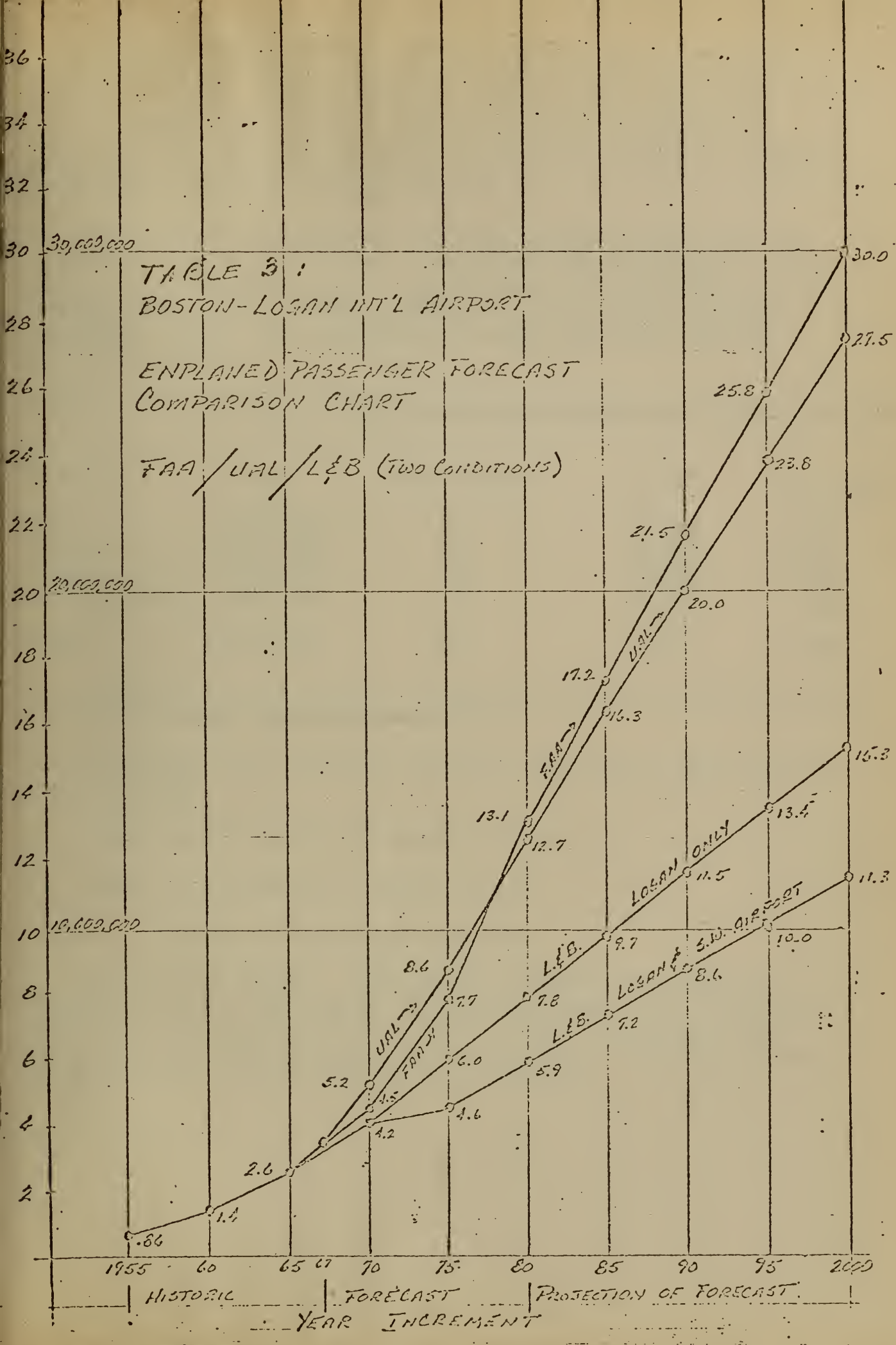


TABLE 3 :
BOSTON-LOGAN INT'L AIRPORT
ENPLANED PASSENGER FORECAST
COMPARISON CHART
FAA / UAL / L&B (TWO CONDITIONS)
30,000,000
20,000,000
10,000,000
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
30.0
27.5
25.8
23.8
21.5
20.0
17.2
16.3
15.3
13.4
13.1
12.7
11.5
11.3
10.0
9.7
8.6
8.6
7.8
7.7
7.2
6.0
5.9
5.2
4.6
4.5
4.2
2.6
1.4
.86
UAL
FAA
L&B
LOGAN ONLY
LOGAN & AIRPORT
1955
60
65
67
70
75
80
85
90
95
2000
HISTORIC
FORECAST
PROJECTION OF FORECAST
YEAR INCREMENT

As indicated in Table 3, there is presently a considerable difference of opinion on the forecast of air travel at Logan Airport in 1980. Federal Aviation Administration forecasts 13.1 million enplaned passengers; United Airlines in conjunction with other airlines serving Logan predicts 12.7 million enplaned passengers; and Landrum and Brown forecasts 7.8 million enplaned passengers. (without a second airport)

The present vehicular mix at Logan Airport varies with the terminals used by passengers. Therefore, the Massachusetts Port Authority's consultant, John Carl Warnecke and Associates, has assigned the volumes shown in Table 3 to the various airport terminals and has also estimated the daily and peak hour air passenger volumes.

TABLE 4: Projections of Annual Enplane Passengers by Terminal in 1980

Terminal	Annual[1]	Distribution[2]	Daily[3]	Peak Hour[4]
North	4,460,000	32	17,800	2,120
Eastern	4,340,000	31	17,400	2,100
South	4,200,000	30	16,800	2,000
International	1,000,000	7	4,000	480
Total	14,000,000	100	56,000	6,700

1. Based on Federal Aviation Administration forecasts of domestic and international enplaning passengers.

2. Projected from historical records furnished by Massachusetts Port Authority.

3. Taken as 0.4 percent of annual volumes.

4. Taken as 12 percent of daily volumes

III·2. Profile of Average Air Traveler

In its 1963 report "Air Traffic Patterns and Community Characteristics", the Federal Aviation Administration classified the Boston Metropolitan Area as a "balanced" community. This means that the area has about average traffic generating ability in relationship to the community's population.

Landrum and Brown in its study of the Air Transportation Potential and Facility Requirements in the Metropolitan Boston Air Service Area stated: "Studies made for other communities have indicated that there is a relationship between family income and the likelihood to use air transportation. Families with higher incomes are more likely to use air transportation than are lower income families. Nearly 30 percent of the study areas' households had incomes over $10,000 currently, as compared to about 20 percent for the United States as a whole."

Estimates provided by the Metropolitan Area Planning Council indicate that by 1990, about three-quarters of the families in the area will have incomes of over $10,000. This means a very substantial increase in the number of families in the groups that are primary users of air transportation. This relationship between family income and air transportation use is found to be true both in terms of air passenger travel and general aviation aircraft ownership.

Landrum and Brown also state: "Many studies have established the validity of the air passenger's residence as the primary point of local origin and destination. Such studies have indicated that over 80 percent of all local air passengers either originate or terminate their air trips at their home, and over 70 percent originate and terminate their air trips at home."

The findings of a recent study made for the Los Angeles Department of Airports indicated that eighty percent (80%) of the local air passengers have their home as their local point of origination, eighty-three percent (83%) have their home as their local point of destination, while seventy-one (71%) percent of these local air passengers both originate and terminate their air trips from their home. No changes in the findings are realized when measurements are made from business and industry locations rather than residences, particularly for "shuttle" air passengers.

III.3. Periods of Peak or Slack Air Traffic Activity

As at most airports Logan has a morning and afternoon activity peak. Generally the morning peak is from 7:00 to 9:00 and the afternoon from 4:00 to 6:00 Monday through Thursday peaks are fairly uniform. Saturday is a low volume day. Sunday does not have a morning peak, but its afternoon activity is often the highest of the week. The summer months have the highest volume of air travel. In fact, approximately 60 percent of international air travel occurs during July and August.

III.4. Air Cargo

Another major growth factor at Logan Airport is the increase in air cargo. During fiscal 1968 air cargo totaled 200,000,000 pounds. In fiscal 19 59 the total was approximately 49,705,308 pounds. (See Table 5) Air cargo requires trucking to and from the Airport. The increase in the number of trucks adds to the airport vehicular traffic and much of the volume occurs in the late afternoon and early evening: before, during and after the five o'clock rush hour traffic.

TABLE 5: GROWTH OF AIR CARGO AT LOGAN AIRPORT -- 1959-1968

Fiscal Year Ending June 30	Cargo Pounds	Percent Increase
1959	49,705,308	-
1960	57,436,001	15.6%
1961	71,020,414	23.7
1962	83,420,439	17.5
1963	88,390,261	6.0
1964	98,676,140	11.6
1965	127,486,319	29.2
1966	162,909,714	27.8
1967	161,744,235	-0.7 *
1968	195,646,620	

*Volume affected by airlines strike

Source: Massachusetts Port Authority

III.5. New Aircraft Technology

A factor that may increase ground traffic congestion during traffic peaks is the number of aircraft carrying over 200 seats that are about to become operational. The Federal Aviation Administration forecast of Airport aviation activity, 1970-1980 forecast that on the latter date approximately 29 percent of the air carrier aircraft operations at Logan Airport would be by group X (over 200 seats). At present the majority of aircraft at Logan Airport carry less than 120 seats and those with 200 seats are minimal.

The introduction in late 1969 of the Boeing 747 Jumbo Jet with between 450 and 500 seats heralds a new magnitude of commercial airliner and new burdens for ground transportation. The Jumbo Jets will carry more than twice as many passengers as the largest present day airliners. The passenger service problems will be heaviest when these planes unload. In contrast to the time-spread of passengers arriving for enplaning, a concentration of demand will occur within a few minutes of a Jumbo Jet's arrival. Over a hundred taxis might be needed if present modal preference for transportation continues. Baggage handling systems are being redesigned and consideration given to pre-checking of bags so that they could be picked up at remote parking lots. Whether such remote pick-up of luggage could be included in a transit system is worthy of consideration.

Vertical and short takeoff and landing (V/STOL) aircraft may have a significant effect on business men's air travel. They may be able to fly from CBD to CBD within a range of 300 miles. Presently the CAB is holding hearings to set criteria for V/STOL aircraft and facilities in the Northeast Corridor. Operations may be authorized by 1972. STOL aircraft with 60 seat capacity have been demonstrated at Logan Airport on a 1,500 foot runway. These aircraft have computerized guidance systems that control takeoffs and landings with prescribed patterns and virtually eliminate the need for navigational aids currently in use. Also, V/STOL aircraft make use of the low level air space in the cruising phase of flights whereas the standard takeoff and landing planes use the higher levels. Greater air space utilization should result.

III.6. Flight Restrictions

Current restrictions on the number of flights permitted per hour at some of the major airports may reduce the number of shuttle flights between Boston and New York. Hourly quotas have been established by the Department of Transportation for flights between 6:00 AM and midnight. These quotas are designed to prevent a recurrence of air traffic jams in the New York City area. On July 19, 1968, almost 2,000 flights in the air and on the ground at Kennedy, LaGuardia and Newark were delayed up to three hours.

No long term improvement is expected in the congestion of aircraft movements during peak summer travel until airway control systems are improved and airports expanded. One effect of the quota system may be to increase the number of flights during the non-quota hours of midnight to 6:00 AM. If such develops the number of air travelers moving between CBD's and airports may decrease. Businessmen may find it difficult to schedule a flight from Boston to New York at the end of their working day and may be forced on occasion to leave home at nighttime hours that will result in their arriving in New York between midnight and 6:00 AM.

III.7. Estimated Saturation Levels for Air Terminal Facilities

To forecast future limitations on air service at Logan Airport, technicians estimate what is termed the Practical Annual Capacity (PANCAP) of the airfield. However, this capacity is estimated by using many variable factors such as runway variations, types of aircraft using the airfield, instrument approach path length variations, instrument departure paths available, operating rules, etc.

Even such a relatively simple forecast as the number of passengers expected in 1980 may vary as much as 70 percent among experts. Landrum and Brown predict 7.8 million enplaned passengers at Logan in 1980; while the FAA and airline forecasts are in the neighborhood of 13 million enplaned passengers. Landrum and Brown estimate Logan's PANCAP as 383,000 aircraft movements a year. If a second air carrier airport were constructed by 1975, Logan would not reach this capacity until after 1990. Other estimates without a "Southwest Airport" set a practical annual capacity at Logan in 1975.

Landrum and Brown state: "Traffic forecasts indicate that Logan should reach its peak airfield capacity development in the 1975 to 1980 period. Future increases in air carrier traffic would be handled through a redistribution of traffic between Boston Southwest and Boston-Logan International. Acreage requirements will escalate until 1975 when Logan's physical facilities equate with the attainable airfield capacity. Increasing delay would be encountered with the development of additional facilities beyond this point."

In order to provide adequate distribution for the personal and corporate aircraft described as General Aviation , the Landrum and Brown report proposes that a system of publicly owned airports be established in the Boston Metropolitan Area.

PART IV - GROUND ACCESS SUB-SYSTEMS AT LOGAN INTERNATIONAL AIRPORT

IV.1. Services Provided for Automobile Sub-system

The present services for private automobiles at Logan International Airport include the access roadways and extensive parking facilities. Access roadways to the air terminal buildings are three lanes wide and connect directly to all existing air terminal buildings in a one-way pattern. Through the recent construction of a two-level roadway, access to air terminals is separated according to desired access points in the air terminal area.

Parking facilities are provided in the new parking garage and on the surface. In the newly-constructed three-level parking garage, 3180 spaces are provided. An additional 2931 spaces are provided in surface parking lots and 159 spaces are provided at meters. Planned parking facilities include 2700 spaces enclosed by the proposed South Terminal and 1000 parking spaces on four levels in the new Southwest Terminal building. The addition of these two facilities will provide a total of 6880 spaces in structures at Logan Airport.

Parking facilities for employees total 1100 spaces. Most facilities are located adjacent to airline facilities at the Airport, and are operated for use by employees of the airlines.

IV.2. Services Provided by Commercial Ground Transportation Sub-system

At Logan Airport there are three commercial transportation services. They consist of Airline bus service, taxi service and limousine service.

Airport Taxicab Service Taxicabs at Logan Airport are provided by a variety of companies, including: Checker, Town, Boston, McMann, Clary, Yellow and Park Square. In addition there are approximately 1000 privately operated cabs. To solicit at the airport, all cabs are required to be licensed by the Boston Police Hackney Bureau and display a bureau medallion on each vehicle.

During average weekdays from fifty to sixty cabs are available at the Airport, On Fridays and Sundays this number is increased to 150 cabs available for service. All cabs charge meter rates from the Airport to destinations of passengers. If the cab passes through the Sumner-Callahan Tunnel, twenty-five cents is added to the fare. Average rates to destination vary according to routings and time spent in transit, but the following figures may be used for comparative purposes:

Airport - Park Square	$2.50 plus 25¢ for tunnel
Airport - Government Center	$1.90 plus 25¢ for tunnel
Airport - South Station	$2.10 plus 25¢ for tunnel

Airline Buses Eastern Airlines has a bus which takes their passengers from the main gate to the parking lot. These buses do not leave the parking lot area. Eastern Airlines is the only airline which has this service. Northeast and some of the larger airlines have bus service for their employees, from the parking lot to their places of employment, but these buses are not used for transporting passengers.

Limousines Airway Transportation of 276 St. Botolph, Boston, Mass. operates limousine service from Logan Airport to downtown Boston. A fleet of 15 vehicles is used and can transport 11 passengers in one vehicle. Starting at 7:00 AM - 1:00 AM these vehicles run every ten minutes. Each vehicle has a luggage rack The fare from Logan Airport to all the following points is $1.25: Hotel Madison, Parker House, Park Street subway, Boylston and Tremont Streets, Hotel Bradford, B&W Bus Terminal, Statler Hilton Hotel, Sheraton Plaza, Copley Plaza, Hotel Lenox, Hotel Vendome, Sheraton-Boston, Midtown Motor Hotel, and Hotel Somerset. Service is increased during the peak hours Monday through Thursday - 10:00 AM - 11:00 AM and between 4:00 PM - 5:00 PM. On Sunday the peak hours are concentrated in the afternoon. Airways Transportation has another service which goes to Hanscom Field, Bedford, Mass. This fare is $3.50. All vehicles use the Sumner-Callahan Tunnel.

IV.3. Services Provided by MBTA

The MBTA operates four interconnected rapid transit lines through downtown Boston, one of which - the Blue Line (East Boston-Revere) - passes approximately 1 mile from the terminal buildings at Logan International Airport. Service to the airport from all rapid transit lines is provided through a station at the airport, from which a local shuttle bus connects directly to air terminal buildings along the principal airport access roadway.

MBTA Bus Service Between Airport Station and Logan Airport the MBTA operates a bus shuttle service which varies according to days of the week and hours of peak and off-peak demand. On weekdays, the vehicles which are being used . are 1967 GMC air-conditioned buses. These vehicles have a seating capacity of 38 passengers, and also have a luggage rack at the front of the bus. During the week there are two buses on this route, from 6:00 AM until 11:00 PM. After 11:00 PM the service is cut in half. From 6:45 AM to 9:30 PM there is a bus every seven or eight minutes. After 9:30 PM there is a bus every 9 minutes. From 11:31 PM until 12:56 AM there is a bus every ten or twelve minutes. This route is closed down at 12:45 PM. These buses are operated from the Eagle Street Garage in East Boston.

The buses which operate from Airport Station and Logan Airport on Saturday and Sunday are operated from the Charlestown Arlington Avenue Garage. They are not air conditioned and have no luggage rack. On Saturday, service starts at 5:30 AM and there is a bus every ten minutes. At 6:50 AM there are two buses on this route and there is a bus every 5 minutes, until 9:25 PM. Starting at 9:25 PM until 11:31 PM the buses run every 9 minutes. At 11:31 PM the buses run approximately every 12 minutes until the close of the line at 12:56 PM. On Sunday, service starts at 6:30 AM and runs every ten minutes with only one bus on this line. At 12:21 PM there are two buses on this line and there is a bus every 8 minutes. At 2:04 PM there is another bus on this line which makes a total of three buses operating on this line until 11:00 PM. From 2:04 PM until 11:16 there is a bus every five minutes. At 11:16 PM the service is cut back to a bus every 10 minutes. This service is cut until there is a bus about every 13 minutes until the close of the line at 12:56 AM.

MBTA Rapid Transit Service

The MBTA Blue Line (East Boston-Revere) rapid transit consists of 6.13 miles of track extending from Bowdoin Station in downtown Boston to Wonderland in Revere. Trains are operated on this line from 5:00 AM to 1:00 AM with increased frequency of trains during morning and evening peak hours. More specifically, trains operate on a 5-7 minute headway in the weekday and Saturday AM and PM peak hours. Headway for the evening peak hour trains is 7-8 minutes until 11:00 PM and 9 minutes until closing. In early morning hours and throughout the day on Sunday the headways are 12-15 minutes.

The equipment on this line consists of 88 vehicles seating 44 persons in each car. Trains are ordinarily operated in two-car combinations, except during peak hours when four-car combinations are used. Forty-eight vehicles were constructed in 1923 and 1924 and forty were added in 1951.

IV.4. Preference of Sub-system Access to Logan Airport

From the available evidence, it is clear that most persons traveling to and from the airport use individual vehicular modes of transportation. The largest proportion use private autos, but a significant number use taxicabs or rented vehicles. The proportion of persons using MBTA services is approximately four or five percent, and has remained at this level for the past six years, during which air travel volumes have increased rapidly.

A 1962 survey of air travelers at Logan Airport indicated that MBTA riders formed approximately five percent of all traffic to and from the Airport. This proportion varied little between days of the week, despite significant changes in the use of private vehicles or taxis.

TABLE 6: Mode of Access to Logan Airport, 1962

Mode of Airport Access November, 1962	Percentage Distribution Early Weekdays	Mid-Weekdays
Private Auto, Total	65%	60%
Drove & Parked	50%	35%
Dropped off	15%	25%
Taxi	25	30
Rental, Limousine	5	5
MBTA	5	5
	100%	100%

Source: Survey of Travelers to Airport by Barton Aschman Associates for Massachusetts Port Authority, November 1962

The Massachusetts Port Authority in 1967 surveyed airport access patterns, and found the use of the MBTA bus was relatively stable at five percent, while use of the private autos had increased slightly. TABLE 7: Mode of Access to Logan Airport, 1967

Mode of Airport Access April, 1967	Percentage Distribution
Private auto	68.6%
Taxi	23.3
Limousine	2.4
MBTA	5.3
	100.0%

Source: Survey of Travelers to Airport by Massachusetts Port Authority, April, 1967

In 1968, a new survey of preference of transportation mode for airport access was undertaken as preparatory work for the Massachusetts Port Authority's development plan for the Airport. This survey indicated what may be a slight decline in the proportion of MBTA riders but the combination of limousine and bus does not clearly indicate respective shares of riders.

TABLE 8: Mode of Access to Logan Airport, 1968

Mode of Airport Access April, 1968	Percentage Distribution
Private Auto	64%
Taxi	25
Rental vehicles	6
Limousine and Bus	5
	100%

Source: Survey of Travelers to Airport by Wilbur Smith & Associates for Massachusetts Port Authority, April, 1968

A survey made by the Port Authority on April 25, 1967 included questions regarding access preference. In these interviews, persons at the Airport terminal were asked their reasons for not using the MBTA. Approximately 42 percent stated that there was no MBTA close to their home or that connections were inconvenient. Another 14.2 percent gave various reasons related to inconvenience and the lack of mobility.

TABLE 9:

Reasons for Not Using MBTA

No MBTA near	27.2%
Connection Inconveniences	14.9
Baggage Inconveniences	17.6
Inconveniences and lack of mobility	14.2
Unfamiliarity	11.7
Too slow	8.4
Not aware of MBTA	3.4
Dirty, unsafe	2.9
	100.3%

Source: Survey of Air Travelers at Logan Airport by Massachusetts Port Authority, April, 1967

IV.5. The Use of Rapid Transit for Airport Access

The MBTA share of traffic to the airport has remained fairly constant during a period in which air traveling has been increasing at a rate of fourteenpercent each year. The absolute number of persons using MBTA services has increased in proportion to the increase in air travel. Table 10 indicates the volume of traffic using the rapid transit Blue Line (East Boston-Revere). Average weekday traffic statistics taken annually from MBTA turnstile counts since 1958 indicate that approximately two to three percent of all the entering Blue Line riders used the Airport rapid transit station. The most recent statistics available indicate that this figure in 1967 was 3.36% of all entering Blue Line riders at Airport Station. Not all of these riders were air travelers but there is no information available for park and ride or kiss and ride passengers at Airport Station.

The most revealing finding from Table 10 is the steady weekday increase in the number of persons entering the turnstiles at Airport Station between 1962 and 1967. In this five year span, traffic rose from 1,000 to 1,600 riders, an increase of 60 percent.

Variations in the use of rapid transit depend on days of the week and months of the year. Chart 11 indicates three-year variations by day of the week, with the heaviest traffic falling generally on Fridays. Traffic on Fridays through Airport Station was nearly thirty percent higher than average weekday traffic in 1963, 1964 and 1965. Traffic on Saturdays was consistently the lowest, where viewed as a percentage of the average weekday traffic at Airport Station. Average Friday boardings at Airport Station, when charted by months of the year, show peaks occurring in midsummer, generally in June, August and September. Chart 12 indicates increasing volumes of Friday traffic between 1963 and 1965, with the highest volumes reported in the summer months of 1965. Chart 13 indicates the highest volumes in average weekday boardings also occurring in 1965, with the exception that the peak months for boardings occur in late fall and early winter. The number of boardings is somewhat lower for weekdays than for Fridays. Chart 14 indicates variations by month, with higher statistical variations occuring at or near the end of each of three years.

...illions

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
LUE LINE										
owdoin	1,600	1,500	1,500	1,400	1,100	900	1,100	1,100	1,500	N.A.
overnment Center (1)	7,600	7,200	6,600	5,900	4,700	4,400	4,700	5,000	5,500	6700
ate (2)	19,000	18,100	18,300	16,400	16,900	16,700	16,100	20,400	15,800	15700
quarium	2,800	2,800	2,700	2,400	2,200	2,400	2,200	2,200	2,100	1900
verick	8,100	8,400	8,100	7,200	6,900	6,600	6,100	6,200	6,300	8000
rport	1,200	1,000	1,000	1,000	1,000	900	1,100	1,200	1,300	1600
od Island Park	5,000	4,800	4,500	4,300	4,000	3,900	3,800	3,900	3,800	3300
ient Heights	5,300	5,300	5,000	4,500	4,600	4,500	4,200	4,100	4,200	4000
ffolk Downs	200	200	200	200	200	200	200	200	200	200
nchmont	1,900	2,000	2,000	1,900	1,800	1,800	1,900	1,900	1,800	1600
vere Beach	1,500	1,600	1,600	1,700	1,500	1,400	1,500	1,600	1,800	1500
nderland	4,100	3,600	3,600	3,700	3,700	3,200	3,600	4,200	3,800	3100
	53,300	56,500	55,100	50,600	48,600	46,900	46,500	52,000	48,100	47,600

CHART 11

DAY OF WEEK AND HOLIDAY ADJUSTMENTS 1963-1965
AIRPORT RAPID TRANSIT STATION

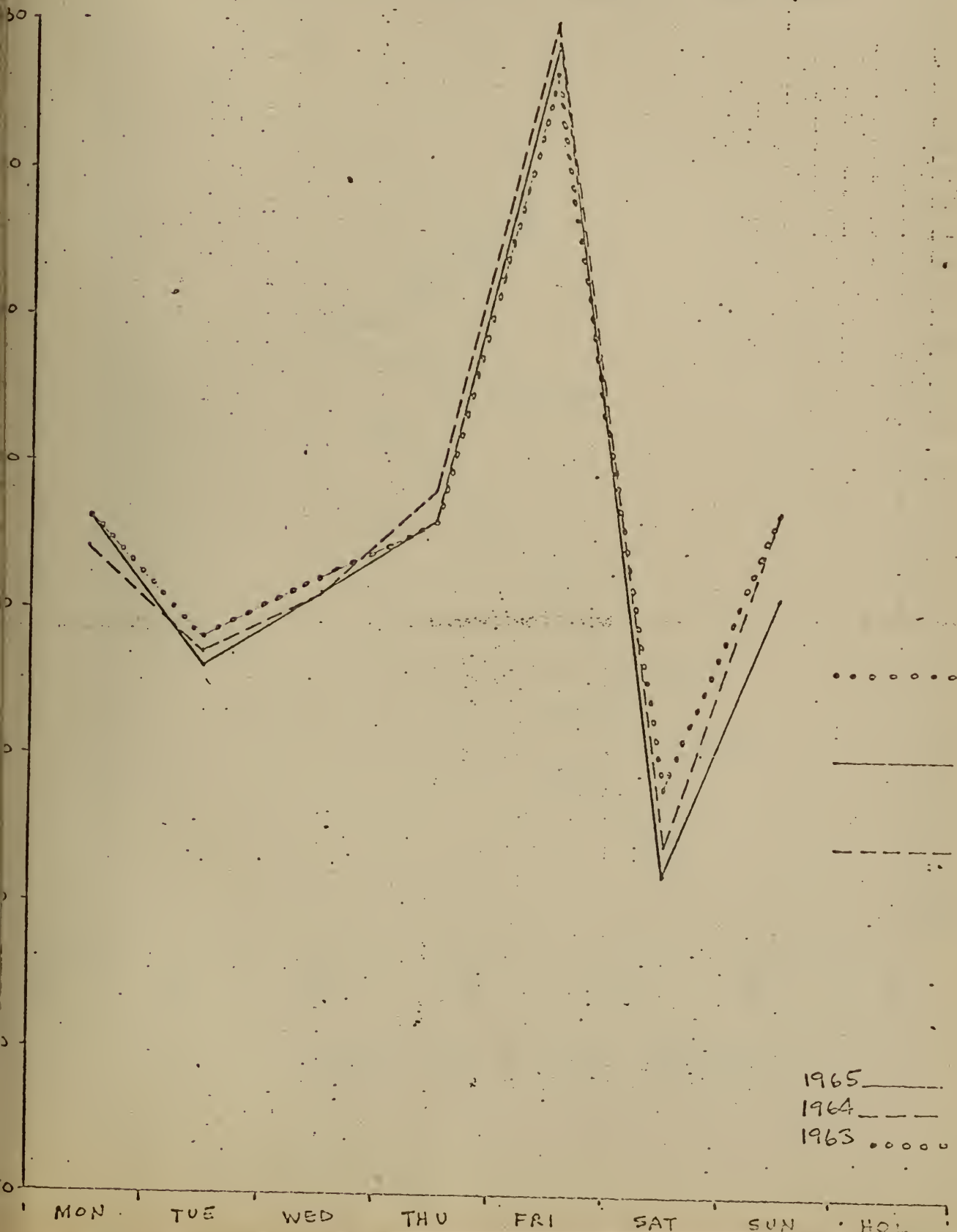


CHART 12

AVERAGE FRIDAY BOARDINGS 1963-1965
AIRPORT RAPID TRANSIT STATION

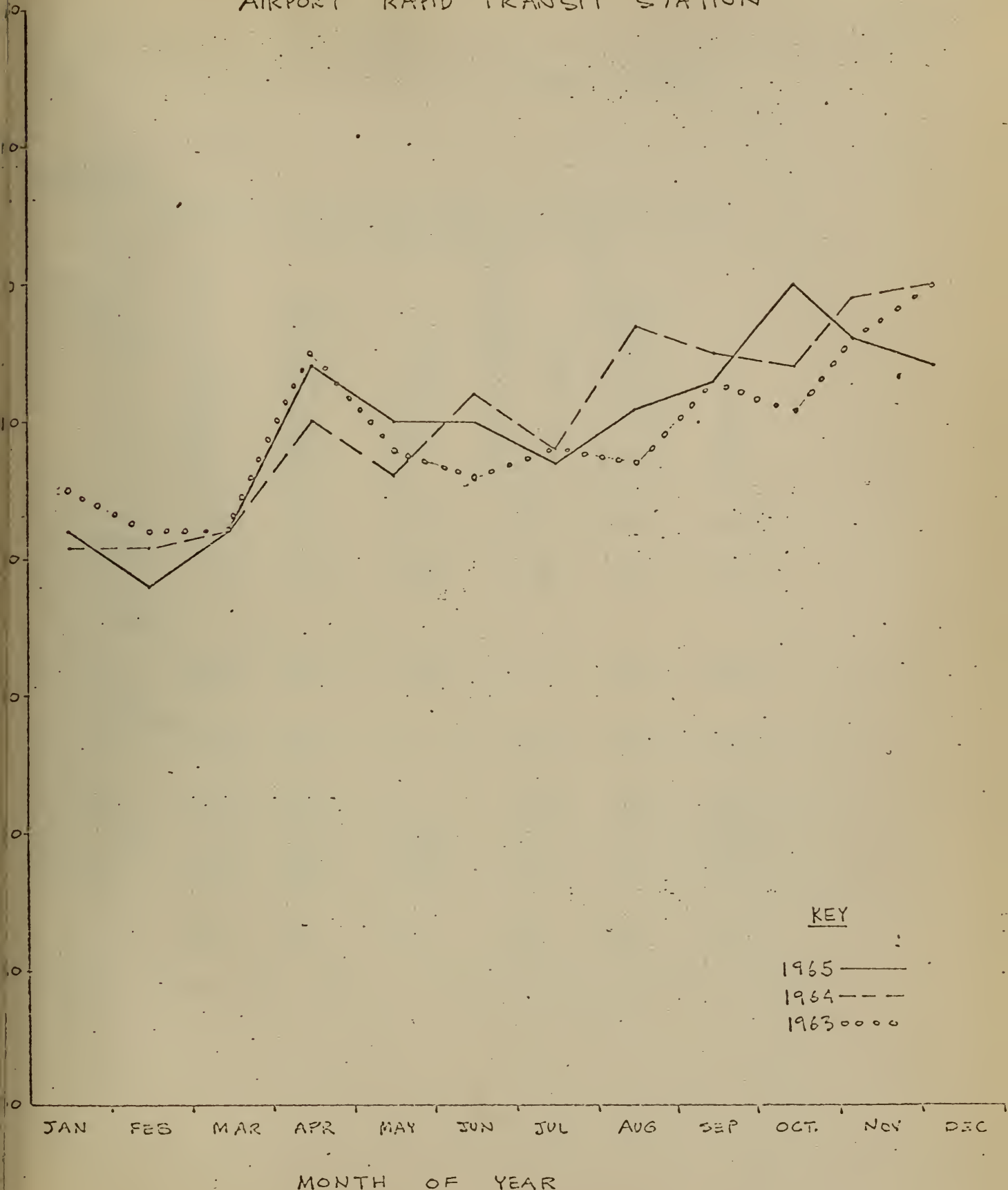
AVERAGE WEEKDAY BOARDINGS 1963 - 1965
AIRPORT RAPID TRANSIT STATION

AVERAGE WEEKDAY BOARDINGS
1500
1400
1300
1200
1100
1000
900
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1963
1964
1965

CHART 13

CHART 14

MONTHLY ADJUSTMENTS 1963-1965
AIRPORT RAPID TRANSIT STATION



Purpose of Trips to and from Logan Airport

Table 15 indicates the purposes of trips by modes to and from the Airport. It is based on a Friday survey taken in 1962 by the Barton-Aschman Associates. It indicates a preponderance of private vehicles and taxicabs for access both to and from the airport. It indicates that more people who were traveling to and from the airport for work or business purposes used the MBTA than any other grouping. It also indicates that slightly more departing passengers use MBTA than those who are arriving at the Airport by plane.

TABLE 15:

Purpose of Trips and Mode of Transportation to or from Airport, 1962

Mode of Transportation	Arriving Airline Passenger	Departing Airline Passenger	Work or Business	Ticket Purchaser or Sight-seer	Seeing Passenger Off or Meeting One Coming In	Unknown
Drove Auto & Parked	20%	15%	68%	79%	92%	36%
Drop or Pick-up with parking	7%	4%	2%	5%	1%	5%
Drop or Pick-up - no parking	10%	8%	5%	-	1%	10%
Rental Auto	9%	17%	-	7%	1%	6%
Taxicab	27%	31%	-	6%	2%	14%
Limousine	6%	7%	1%	-	-	17%
MTA	4%	6%	21%	3%	3%	12%
Unknown	17%	12%	3%	-	-	-
	100%	100%	100%	100%	100%	100%

Source: Survey for MTA by Barton-Ashman Associates, 1962

The MBTA Bus Shuttle Service at Logan Airport is used principally for connections to the Blue Line rapid transit station. For this reason, it has been fruitful to interview bus riders to ascertain detailed information on the purpose of airport access trips by public transportation.

Riders of the bus shuttle service were interviewed on June 10, 1966, and the results of that survey are portrayed in the following table. It is noteworthy that over forty percent of bus shuttle riders were either students or airport employees and that twenty-three percent were professional or business people. Approximately 52% of those interviewed were air passengers, which included those who used the bus for "Business", "Recreation/Vacation" and "Family purposes". Nearly one-fourth of all trips were either to or from work at Logan.

TABLE 16

Airport Loop Bus Passengers
By Occupation By Trip Purpose
Friday, June 10, 1966

PURPOSE / ON	BUSINESS Trip	RECREATION VACATION Trip	FAMILY	MEET OR SEE OFF PASS.	SIGHTSEE	OTHER, UNKNOWN	TO OR FROM WORK @ LOGAN	TOTALS, BY OCCUPATION
onal l	9.1	3.5	2.7	1.9	.3	.9	.0	18.5
man	3.5	.4	.3	.5	.0+	.2	.0	5.1
lar	1.3	2.2	1.2	2.8	.2	.9	.0	8.7
	1.1	5.6	7.6	3.0	.8	2.5	.0	20.7
e	.0+	0.8	.3	1.8	.3	.6	.0	3.8
ss	.0	.0	.0	.0	.0	.0	3.1	3.1
rport	.0	.0	.0	.0	.0	.0	21.0	21.0
rces	.6	1.4	8.8	.5	.0	.6	.0	12.0
nknown	.4	.9	.7	1.0	.0+	3.9	.0	7.2
BY PURP.	16.0	14.9	21.8	11.6	2.0	9.7	24.0	100.0

Source: Survey for MBTA by Peat, Marwick, Livingston & Co., Friday, June 10, 1966

Source:
Survey for MBTA by Peat, Marwick, Livingston & Co., Friday, June 10, 1966

PART V - POSSIBLE DEFICIENCIES IN FUTURE GROUND ACCESS TO AIRPORT

V.1. Private and Commercial Access

With rapidly increasing air passenger volumes and introduction of aircraft with more than two hundred seats, the impact on the vehicular tunnels between downtown and Logal Airport may be severe. Even the present volumes reaching to 70,000 vehicles a day cannot easily be accommodated during peak hours. The cross traffic on the streets of the downtown side of the tunnels and the lack of adequate access roads causes traffic to be congested despite the cooperation of the City of Boston Traffic Commission, State Department of Public Works, Massachusetts Turnpike Authority and Massachusetts Port Authority. The latter two organizations contributed $8050 each to the widening of Cross Street between the Callahan Tunnel and Haymarket Square in order to ameliorate a bottleneck. The Central Artery average daily volumes are in excess of 100,000 vehicles and slowdowns during adverse conditions are frequent. Traffic during rush hours also backs up on McLellan Highway on the East Boston approach to the Callahan Tunnel. At times, the airport exit road traffic has been halted as drivers slowly edged their way onto McLellan Highway.

Proposals for alleviating the Central Artery overloading are primarily concerned with a Third Harbor Tunnel. Presently it is planned to have it extend from the Fort Point Channel on the Boston side to the McLellan Highway in East Boston. Relief of the Central Artery by the Third Harbor Tunnel will result only if proper connections are provided with Interstate Highway 95 in Revere and the Massachusetts Avenue area of the Central Artery in the South End of Boston. If the Massachusetts Turnpike Authority is able to obtain authorization and financing for the Third Harbor Crossing, the tunnels operated by the Authority in 1975 are expected to have a total volume of approximately 39,000,000 annually, under one set of assumptions. Should the crossing provide a rapid transit line or an exclusive bus lane, it would give impetus to improved access between the Airport and the South Station section of the CBD.

A new stadium in the South Station area would increase traffic in the proposed tunnel, especially in periods immediately before and after sports events.

This prospect not only emphasizes the need for a Harbor Crossing that would accommodate trucks and automobiles but also a rapid transit line or an exclusive bus lane.

V.2. Ability of MBTA Services to Handle Future Ground Traffic

A possible deficiency in public mass transportation service may result from the lack of direct rapid transit access to the Logan air terminal buildings. The present bus shuttle service will be adequate to handle mass volumes in inverse proportion to the congestion on the airport access roadways. When congestion develops, either because of air or ground traffic, buses will become less attractive as a means of access to or from the Airport. There is already the problem of transferring between planes to buses and rapid transit at the Airport, which is an inconvenience for many travelers, and which severely limits the potential use of public mass transportation vehicles. Street congestion which delays buses would only add to the harassment of potential riders.

Transfers between rapid transit lines forms an additional obstacle to attracting riders. The Blue Line (Airport to Downtown) provides four stops downtown - one of which is the end of the line. A transfer to another line - either rapid transit or bus - is therefore mandatory for passengers with destinations removed from these four stations: Aquarium, State, Government Center and Bowdoin. The transfers can be effected at either State or Government Center Station to the Forest Hills-Everett (Orange) Line or to the streetcar subway (Green Line). To reach the Harvard-Ashmont (Red Line) rapid transit, another transfer is required, at either Washington or Park Street stations. The difficulties of multiple transfers, particularly with hand luggage, may well be insufferable for most potential passengers.

Additionally, the problem of luggage handling on public mass transportation vehicles is a nearly insurmountable obstacle for attracting passengers, particularly when numerous transfers are involved. Although porters are available between planes and buses, there is no equivalent service offered between buses and rapid transit or between rapid transit lines. Luggage racks are available on some of the airport buses, but not on weekends, when the specially equipped buses are inactive and regular buses are called in from another bus garage.

Landrum and Brown in the recent Study of the Air Transportation Potential and Facility Requirements in the Metropolitan Boston Air Service Area estimates that in 1990 the Boston area will have a potential for 14,435,000 enplaned passengers. Approximately 7,800,000 of these passengers will be locally-originating (those enplaned air passengers who are residents of the Metropolitan Boston Air Service Area).

Of these almost 8 million passengers, only a little more than 10 percent or 810,000 are attributed to the City of Boston (See Table 17).

TABLE 17: Potential Market for City of Boston Air Travel, 1990

	1990 Local Generated Air Passenger Potential	
Community	Percent of Total Study Area Potential	Number of Air Travelers
Boston	1.37%	106,900
South Boston	.64	49,900
Roxbury	.46	35,900
Charleston	.31	24,200
East Boston	.45	35,100
North Dorchester	.99	77,200
Fenway-Jamaica	1.54	120,100
Brighton	1.01	78,800
South Dorchester	.63	49,100
Mattapan	.43	33,500
Hyde Park	1.05	81,900
West Roxbury	.79	61,600
Roslindale	.72	56,200
TOTAL BOSTON	10.39%	810,400

Source: Landrum and Brown, A Study of the Air Transportation Potential and Facility Requirements in the Metropolitan Boston Air Service Area, 1968

Other recent studies have indicated that the Central Business District has declined in the proportion of travelers using it as their origin and destination for ground transportation. William S. Beller writing in "Space/Aeronautics", September 1967 stated: "Traffic patterns are not static even for a few years. A misconception of some is that the greatest transportation demand within a city is for moving people to and from the Central Business District. Although current studies show that the Central Business District is indeed a powerful magnet still in some large cities less than 10 percent of total trips start and end there. In Pittsburgh, the CBD-Airport traffic is seven percent of the total and in Washington, D. C., 35 percent, showing how widely figures vary. Projections for future air travel show that the popularity of many Central Business Districts will not increase although total urban travel within the associated metropolitan area will double over the next 25 years. For example, in the Chicago metropolitan area only 9 percent of total trips during the week start or end at the loop, heart of Chicago's Central Business area. Projected statistics for 1980 indicate that travel to and from the loop will not increase at all, but total person trips for the entire area are expected to rise 77 percent."

Nearly all studies of airport access have disclosed that Central Business Districts throughout the country are generally providing a smaller percentage of air travelers than formerly; that high-speed jet transportation allows many air travelers, especially businessmen, to leave their homes in the morning and return to their homes at night after an air trip of upwards of 1,000 miles; and that these homes are generally in high-income residential communities.

V.4. The Emerging Problem: Summary of Logan Airport - Air and Ground Traffic Projections

In 1968, Logan will serve approximately four million enplane passengers or eight million total passengers. This means the airport handles 16,000 enplane passengers per day and 1,600 at peak hour. Air passengers are only part of the total population drawn daily to the airport from the community. A survey of the airport population shows that each passenger generated 0.8 non-flying visitors, or almost one visitor per passenger. The other important part of the population are the employees of various airport facilities. The total airport population is therefore more than twice the passenger count. These three groups generate the major movement to and from the airport. At peak hour, 2,200 cars now enter the terminals on the airport road system. Roads are the path system used by almost all passengers. The high use of autos

requires large parking areas. At present, 5,800 parking spaces are needed and provided for passengers and visitors. Of these, 3170 spaces are located in the new three-level parking garage. Employee parking is found surrounding various tenant facilities.

The passenger growth rate at Logan used for the study has the airport serving 9.8 million annual enplane passengers by 1980. This rate is slower than those predicted by airlines. With respect to today's totals, the airport will double its passenger volume by 1980. Translating these figures into vehicular volumes and parking requirements reflect the scale of problems to come. By 1980, 13,700 parking spaces for passengers will be required with 4,000 other spaces needed for employees. The peak hour traffic will have 5,800 vehicles entering the airport, while the present three lanes of entry road could have a capacity of 3,600 vehicles per hour. The ultimate capacity for passenger parking on present M.P.A.-owned land is 14,600 spaces if five level parking structures are constructed on available land. Parking may eventually have to be provided beyond the present airport bounds. Ultimately, employee parking will require 6,000 spaces if the automobile continues to be the only major transportation mode. The development of cargo facilities on the Bird Island Flats could further intensify the problems of moving people and goods primarily on a road system. This airport is becoming a major job center and the employees need economic public transportation to get them to work areas.

The growth of Logan Airport will in time strain even an expanded road system on the airport. A study for the Third Crossing Boston Harbor shows that roads leading to the airport will also be strained. The physical layout of the airport is such that in time it will not be able to accommodate all the autos that would want to be parked. It is apparent that passengers, visitors, and employees will have to find alternate ways to enter the airport property. If autos continue to be the only way people move to the airport, remote parking will have to be developed with a means of moving people between terminals and parking.

Air passengers who visit Boston are not the major cause of the parking problem. It is the passenger residing in the Boston area, the accompanying visitors, and the airport employees who use the parking spaces and generate much of the traffic volume. A study to determine feasible alternative ways of traveling to and from the Airport to the CBD and other residential areas is certainly relevant. As discussed above, the Airport is from an air and runway capacity point of view capable of handling 15 million annual enplane passengers. The ground parking and road facilities, when

expanded to the maximum possible on the land available, will be congested by the 12 million annual enplane passenger level. This apparent problem caused by passengers will be compounded by the increased traffic to be generated by airport employee growth, caused by expanding cargo facilities and passenger terminals. It will be necessary for passengers, visitors and employees to find alternate means of getting to Logan Airport. A study now defining the movement problem and investigating modifications which would make the subway system a satisfactory alternative will certainly be a step towards helping the total development of Boston air transportation facility and also the improvement of the MBTA system.

PART VI: CONCLUSIONS: THE POTENTIAL FOR IMPROVING PUBLIC MASS TRANSPORTATION TO LOGAN AIRPORT

Although Logan International Airport was constructed in 1923, it was not immediately served by public mass transportation. In 1945, the first bus service to the Airport was provided by the Massachusetts Transportation Authority, with connections to the Maverick Square rapid transit station in East Boston. In 1952 the East Boston rapid transit line was extended to Orient Heights and a combination bus and rapid transit station was opened near the Airport. Bus shuttle service to the air terminal buildings was initiated at that time. In 1967 the Airport rapid transit station was refurbished and escalators were added to provide improved pedestrian connections between the rapid transit and bus services.

The provision of rapid transit and bus service to the Airport terminal buildings at Logan has many built-in difficulties which were outlined in the Introduction. However, the problems must be overcome if public mass transportation is to be a more useful element in handling the increasing number of travelers and the overwhelming problems of ground access to the Airport. Possible methods for improving the situation are detailed below.

VI.1 Rapid Transit Improvements

There are several possibilities for improving rapid transit access to the Airport terminal buildings. Essentially these improvements can be grouped into two categories: (1) Improvements at the Airport; (2) New downtown rapid transit connections.

The basic problem of rapid transit access at the Airport is the use of the shuttle bus and the required transfer to the rapid transit line at Airport Station, approximately one mile from the Airport terminal buildings. To alleviate this situation, one alternative course of action is the extension of the rapid transit spur to the terminal buildings.

The construction of a spur rapid transit track into the air terminal building concentration is a valid alternative. It could be accomplished by construction of a connection from the existing rapid transit line, either north or south of the present Airport rapid transit station, although the configuration of trackage and the assignment of vehicles might point toward the use of the south approach as the more desirable. The spur would be approximately one mile long and could be constructed with little difficulty up to the existing parking garage.

The advantages of this construction is to minimize the need for transferring from one rapid transit vehicle to another. The construction and operation of a rapid transit spur to the airport terminal building area would provide more direct service into the area of greatest potential rapid transit demand. The connection could thus provide direct downtown to airport service without the necessity for the transfer between rapid transit vehicles and buses at Airport Station.

Construction difficulties will undoubtedly be encountered in the terminal building area which includes the garage. Construction will be most complex and difficult due to the extensive building which already exists. Subsoil conditions at Logan have resulted in major installations of deep piles on which the terminal buildings and the parking structure rest. The existence of the piles and the unstable subsoil conditions are severe limitations on an underground rapid transit connection. Above ground, the new parking garage and the configuration of the air terminal building place additional strictness on the construction of a rapid transit facility.

New construction at the airport has evolved from the attempt to maximize the use of Logan's original structures while gradually supplementing the older buildings with new, decentralized facilities. This dispersion of facilities has a major impact on the possibility of rapid transit service. Potential transit riders, widely scattered throughout the terminal area, do not provide a focus of demand which justifies rapid transit construction. With one or possibly two stations, a rapid transit line might not be justified unless suitable convenient pedestrian connections to the transit station could be constructed. An additional possibility is the construction of a rapid transit loop which could connect more directly into the air terminal buildings.

The Central Area Systems Study (CASS), currently underway, has the principal goal of examining and recommending a possible connection between the East Boston (Blue Line) rapid transit and the Riverside (Green Line) streetcar subway, and converting the entire line to an integrated rapid transit operation. A possible amendment to the study includes extensions of both the Blue and Green Lines to the western and North Shore suburbs. On November 13, 1968, in an open meeting, the MBTA Board of Directors approved amending the CASS technical study project to include extension of the Blue Line rapid transit to the North Shore and to the airport terminal buildings. Colonel S. H. Bingham Associates was designated as consultant for this project. Work on this project will shortly be started by the consultant.

VI.2 New Downtown Rapid Transit Connections

One of the major difficulties in providing improved mass transportation between the Airport and downtown is the statistical evidence that rapid transit riders between these two points is declining as a proportion of the total number of riders. The MBTA, in providing improved service between downtown and the airport, has examined proposals which would improve the overall mass transportation service pattern, while enhancing access to and from the airport.

Several extensions of the rapid transit lines are already under construction or well advanced in planning. The lines which are not being extended by currently improved plans are included in the Central Area Systems Study (CASS). This effort has as part of its work a connection of the East Boston (Blue Line) subway to the Riverside (Green) Line, including new trackage, construction and equipment designed to correspond with the high-speed, high-platform equipment of the East Boston Line. This connection, if approved and constructed, would provide through service from the western suburbs to the North Shore, with a spur to the Airport. This spur and a possible extension of the East Boston line northward are now included in the CASS effort, and are being examined at the present time.

An alternative to the extension to the Riverside line from East Boston is in early planning stages. This proposal envisions a connection from the Riverside line to the East Boston line via South Station and a new harbor crossing parallel to and perhaps incorporated into the Massachusetts Turnpike Authority's proposed third harbor highway tunnel. It is assumed by this proposal that a major rapid transit station could be provided under the principal air terminal buildings at Logan Airport as a way station on the new North Shore to west suburbs route. The advantages of the scheme include the line distances and hence population served by the one line, and the convenience which could be provided by relatively long distance rapid transit service.

Specific aspects of this proposal include:

(1) Connection of the Riverside line to the Blue Line with downtown stations at the Airport, South Station and Back Bay.

(2) In the Back Bay, a joint station with the Orange Line extension could be possible. Study of the proposal might include the feasibility of using Orange Line equipment on the new extension and construction of an interconnection of trackage between Back Bay and South Cove to enable Orange Line trains to operate to the Airport and the North Shore.

(3) A station on the new line at South Station would enable connections to the proposed high-speed rail service to New York and to the Trailways-Greyhound bus terminal planned as part of this complex. If a new stadium is constructed in the area of South Station, access to it would be possible via pedestrian connections (moving belt, etc., through the South Station complex and parking garage).

(4) A new use for the existing East Boston tunnel would have to be found. One possibility is a new Downtown to Airport shuttle service using the new technology of individually-actuated vehicles. Another possibility might be for movement of air cargo, a rapidly growing function of the airport.

(5) This alternative is undoubtedly relatively expensive involving a length of tunnels from the north side of Logan Airport to South Station. If further study of the proposal is desired, it should proceed immediately, in order to include joint feasibility studies with the Mass. Turnpike Authority.

VI.3 Use of the Third Harbor Crossing

The possibility of a third Boston Harbor crossing currently being studied by the Massachusetts Turnpike Authority, affords an opportunity for further exploration of new mass transportation access between Downtown and the Airport. Two possibilities may exist and should be jointly explored by the MBTA and the Turnpike Authority.

(1) Express bus service between South Station and the Airport. Between the airport and downtown, buses could use reserved bus lanes in the tunnel. The principal entry to downtown might be the new bus terminal which has been incorporated in the Massachusetts Port Authority South Station complex. Further access to downtown would have to be provided on local streets. One of the most attractive features of the plan is the possibility of express bus service on the existing turnpike from the west via the new tunnel to the Airport.

(2) Rapid transit extension from Downtown to the Airport via the new tunnel. Using existing railroad rights-of-way, a possible connection from downtown to the airport might be effected by rapid transit and highway joint use of third harbor tunnel from the South Station area to East Boston. An exploratory study of the costs and possible benefits of this plan could be jointly initiated by the MBTA and the Turnpike Authority. If potentially large savings can be realized by constructing the Third Harbor Crossing for both private and rapid transit vehicles, further studies may be warranted.

VI.4 Replacement of the Airport Shuttle Bus

Alternative methods for improving rapid transit services at the Airport center on replacing the Airport Shuttle Bus. As the general support facilities for vehicular access become increasingly congested, surface bus operations become more difficult to operate. Convenience of access to the airport rapid transit station will decline with bus delays and riders can be expected to seek alternative means of access to and from the airport. An alternative method of providing bus connection to Airport Station could be explored to provide for a private right-of-way and thus faster and more convenient access to and from the rapid transit line. Several methods of providing such substitute service are being developed throughout the country. The Westinghouse Skybus; the Barrett Guide-O-Matic system; the STARRcar; the dashaveyor and many others . Whether or not this means of transporting passengers is desirable at Logan needs further study. To justify such a system, additional points of service may need to be developed, such as remote parking lots, served by the same new conveyance as the rapid transit station. (See Appendix C)

Consultants for the Massachusetts Port Authority have recommended, as part of the new master plan for development of Logan Airport, a series of remote parking facilities for air travellers and for airline personnel connected to the air terminal building via a new form of shuttle service. The exact form of shuttle is to be determined, but it is evident that the shuttle may well provide an alternative or replacement for the existing MBTA bus shuttle service. Joint study of alternative forms of the new shuttle should therefore be initiated by the MBTA and the Massachusetts Port Authority.

APPENDIX A

RESOLVE OF JUNE 12, 1968

of the

MASSACHUSETTS HOUSE OF REPRESENTATIVES

Chapter 90.

THE COMMONWEALTH OF MASSACHUSETTS

In the Year One Thousand Nine Hundred and Sixty-eight

RESOLVE PROVIDING FOR AN INVESTIGATION AND STUDY BY THE MASSACHUSETTS BAY TRANSPORTATION AUTHORITY AND THE MASSACHUSETTS PORT AUTHORITY RELATIVE TO THE FEASIBILITY OF OPERATING A HIGH-SPEED TRANSPORTATION SYSTEM FROM GENERAL EDWARD LAWRENCE LOGAN INTERNATIONAL AIRPORT TO DOWNTOWN BOSTON.

RESOLVED, That the Massachusetts Bay Transportation Authority and the Massachusetts Port Authority are hereby authorized and directed to make a joint investigation and study relative to the possibility of operating an improved high-speed public transportation system from the General Edward Lawrence Logan International Airport administration building and from the Massachusetts Bay Transportation Authority airport station to points in downtown Boston. Said authorities shall report to the general court the results of their joint investigation and study, and their recommendations, if any, together with drafts of legislation necessary to carry their recommendations into effect, by filing the same with the clerk of the house of representatives on or before the third Wednesday of December, nineteen hundred and sixty-eight.

House of Representatives, June 12, 1968.

Passed, Robert H. Quinn, Speaker.

In Senate, June 12, 1968.

Passed, Maurice A. Donahue, President.

June 19, 1968.

Approved,

John A. Volpe
Governor.

APPENDIX B

RAIL AND HIGHWAY ACCESS BETWEEN CENTRAL BUSINESS DISTRICTS AND MAJOR WORLD AIRPORTS

Report by the Port of New York Authority, July, 1968

Report on

Rail and Highway Access Between

Central Business Districts and Major World Airports

July 1968

The Port of New York Authority

Summary of Findings

Late in 1966, The Port of New York Authority distributed a questionnaire to operators of major airports around the world concerning ground transportation services between central business districts and metropolitan airports. The survey was designed to identify the value of rail access services as compared to standard highway modes of ground transport.

Accordingly, the airports sampled were chosen on the basis of known or estimated availability of existing or planned rail links to airports. Most of the airports are situated in Europe. Tokyo was included because of its recent monorail installation, and Boston and Cleveland for their rail links - existing and under construction, respectively. In addition, New York City, San Francisco and Washington, D.C. were also included in the United States sample as being representative of the many major cities that are considering the practicability of airport rail transit in a general way now for possible future application.

The questionnaires reveal that about one-half million daily airport travelers of all types enter the 23 airports surveyed in this study of ground access between central business districts and airports. Practically all of them use highway transport modes: automobiles, taxis, coach-limo services, and to a considerably lesser extent, public bus, subway-bus combinations, and helicopter services.

Rail passenger services link 11 of the 23 airports with the central business districts, but collectively serve few airport travelers. Several of the rail lines reach only the peripheries of the airports, and not all of these have bus connections to the airline passenger terminal buildings, drastically limiting their value. Only four of the 23 airports actually have direct rapid transit rail service to the airline passenger terminal buildings. One, Berlin-Tempelhof, is a station on one of the city's subway lines. Two of the airports, Brussels and London-Gatwick, have special railroad service connections. The fourth, Tokyo International (Haneda), has a monorail link.

A rail rapid transit line extension into Cleveland Hopkins International Airport will be completed in late 1968. By early-to-mid 1970's, a railroad link and possibly the Underground are proposed to be extended into London-Heathrow. And by 1980, six other airport railroad or rail rapid transit links will be in operation - all in Europe - if present plans and proposals are consummated.

Central business districts now generate 17 to 50 per cent of total airport traffic at the ten airports reporting this information. Most airports are within 30 minutes of their central business districts during midday and evening hours, but 30-to-60-minute travel times are much more common during peak hours.* The London-Gatwick rail service is a real time saver, being 15 to 45 minutes faster than highway travel. Travel times on the rail service to Brussels Airport and the Tokyo monorail to Haneda Airport are only comparable to highway travel. The new installations to Cleveland Hopkins and London-Heathrow are expected to save considerable travel time compared to highway travel, according to advance estimates.

In this survey, airline passengers account for 27 per cent of all the airport trips, employees 36 per cent, and all others (including visitors) 37 per cent. In general, the planned new rail links will be of service to the airline passengers and "all others" if they are exclusively oriented to central business district-to-airport travel. If links are added to serve intermediate districts, more employee traffic would be accommodated, but en route stops would delay travel and thus inhibit the full development of airline passenger potential. Estimates vary widely with local circumstances and conditions, but as reported, rail service handles anywhere from 20 to 80 per cent of total traffic between central business districts and airports.

The results of this survey suggest that rail access can provide valuable service connections in some cases, but only the most careful analysis of an individual situation can determine its potential patronage and feasibility. However, it is clear that highway travel will continue to be important from the central business district because of personal preferences for automobiles and taxi services. In addition, highways will, of course, continue to be indispensable for access from all non-CBD areas served by the airport.

* * *

Information presented in this report is largely based on responses to the questionnaires, but is supplemented by information from other reference sources of a reliable nature. Traffic forecasts, however, have been obtained exclusively from the questionnaire responses. The design of a standard questionnaire applicable to transportation conditions in so many different cities can at best be a compromise document subject to possible misinterpretation by the respondents and analysts alike. It appears, however, that the bulk of the data is valid.

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*It should be noted that travel times cited in this report generally reflect time spent between the downtown airline terminal and the airport, for both rail and bus modes and do not include travel time to reach the downtown terminal, baggage checking time or distribution time within the terminal. These times, however, are usually reflected in data for automobile and taxicab modes.

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Alphabetical Listing of Airports Surveyed and Type of Rail Service Connections

Airport	Rail Service	Page
Amsterdam-Schiphol	Special railroad service planned by 1980.	1
Berlin-Tegel	Existing remote subway stop 2/3 mile from airline passenger terminal - but no connecting bus service. Direct subway connection planned to new terminal building and scheduled for completion in 1971.	2
Berlin-Tempelhof	Existing direct subway service.	3
Boston-Logan Int'l.	Existing remote subway stop 2/3 mile from airline passenger terminal, with connecting bus service.	4
Bremen	Existing direct on-street tram service.	5
Brussels	Existing special railroad service.	6
Cleveland Hopkins International	Rail rapid transit extension to airport scheduled to open in late 1968.	7
Dusseldorf	Regional rail rapid transit network, including airport link, has been proposed.	9
Hamburg	Existing direct on-street tram service. Also subway-bus routing with en route transfer.	10
London-Gatwick	Existing special railroad service.	11
London-Heathrow	Special railroad service or possibly a subway extension project, proposed for operation by early-to-mid 1970's.	14
New York-Kennedy International	Subway-bus routing with en route transfer available. One-seat rail-bus service proposed. Direct special railroad service under study.	18

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Airport	Rail Service	Page
New York-LaGuardia	Subway-bus routing with en route transfer available.	21
New York-Newark	No rail service envisaged.	23
Paris-LeBourget	Subway-bus routing with en route transfer available. (Airport expected to close in 1975).	25
Paris-Nord	Remote subway stop 2/3 mile from airline passenger terminal, with connecting bus service, planned for 1980. (Airport expected to open in 1972).	26
Paris-Orly	Subway-bus routing with en route transfer available. Buses operate express to airport. Direct subway service contemplated for future.	28
Rome-Fiumicino	Existing railroad stop 1-1/4 miles from airline passenger terminal - but no connecting bus service.	30
San Francisco Int'l.	Extension of Bay Area Rapid Transit System (now under construction) to airport has been proposed.	31
Tokyo Int'l. (Haneda)	Special monorail service available from edge of Central Business District. Two tram services, both with connecting bus services, also available. One transfer point is 2/3 mile from airline passenger terminal; the other is more distant.	32
Vienna-Schwechat	Existing railroad stop 1/2 mile from airline passenger terminal - but no connecting bus service.	35
Washington-Dulles Int'l.	Study of high speed ground transportation link currently underway.	36
Zurich-Kloten	Existing railroad stop 1-1/4 miles from airline passenger terminal - but no connecting bus service. Rail rapid transit from CBD planned for indefinite future.	37

Amsterdam-Schiphol

Schiphol Airport is situated about 8 miles southwest of Amsterdam's Central Business District. In 1965, some 12,700 persons were employed there, and on an average day, nearly 3,000 air passengers entered (or left) the airport together with about 4,000 visitors and sightseers, for a total of 19,700 airport trips in a single direction. A new central terminal area was opened in Spring 1967. By 1975, the airport is expected to serve 7,000 airline passengers in each direction, 15,000 employees, and 6,000 daily visitors, for a total of 28,000 trips in each direction.

Airport-bound travelers currently have their choice of taxis, an airport coach run by KLM, public buses or automobiles. The KLM coach runs non-stop from the Central Terminal in the CBD and the Hilton Hotel, alternating on half hour intervals. The trip takes 30 to 35 minutes depending on time of day and traffic conditions. Baggage handling assistance is available on this non-stop service, although no airline ticket counters exist at the CBD terminals. The fare for this service is $0.55.

The public buses run to the airport as part of a regular intercity service. Buses leave the CBD terminal every 15 minutes, and make 8 stops en route to the airport. This trip takes 35 to 45 minutes depending on traffic. No baggage handling is available, and the airport stop is situated about 100 yards from the terminal. The fare is about $0.24.

Taxis make the trip in 20 to 35 minutes and charge $3.30.

No passenger data is available on modal splits. The Netherlands plans completion of a new high speed railroad line from Amsterdam to Rotterdam by 1980. An airport station will be located directly on this line. Being about a mile from the main center of the Central Business District, the railroad terminal will be slightly less convenient than the coach and bus terminals. The trip should take only 11 minutes, however, and trains are to be frequently scheduled - every 8 minutes in the peak hour and every 10 minutes during off-peak periods. An airline ticket counter check-in point at the railway terminal is not envisaged at this time. The airport stop will be about 100 yards from the airline passenger terminal. The fare for this service will be $0.35.

Berlin-Tegel

Tegel is Berlin's new international airport, located 6 miles from the Central Business District. It is under construction and is currently only used by Air France. In 1966, about 70 employees worked there, and the airport served an average of about 500 daily air passengers in each direction. Some 43 per cent of the airport traffic presently originates in the CBD. When Tegel is completed in 1971, it expects to serve about 4,000 airline passengers daily in each direction.

The airport is served by an airport bus route and the city subway system. Airport buses run directly to the passenger terminal from the CBD to meet specific airline arrivals and departures. Eight stops are made en route with the total trip time amounting to about 30 minutes at any time of the day. The bus fare is $0.20.

The subway takes 25 minutes for the trip, making 13 stops en route, running every 3 to 5 minutes depending on the hour. The airport stop is remote (1000 yards) from the airline terminal, however. The one-way fare is $0.10.

There is no baggage handling accommodation on either the airport bus or subway services. Both services operate from the principal center of the business district and airline ticket offices are nearby.

Taxi service takes 20 to 25 minutes, and the charge is $2.50. Taxis are the most popular mode of airport travel from the CBD, followed by automobiles.

In the plans for development of the airport, the projected new airline terminal will be situated about one mile south of the existing terminal, and will actually be two miles closer to the CBD. The city subway will serve the new terminal building, and the airport management expects the subway to become a major means of transportation to the airport.

Berlin-Tempelhof

Situated about 3 miles from Berlin's Central Business District, Tempelhof served 5,000 airline passengers daily in each direction in 1966, and had a total airport traffic of over 6,000, including passengers, employees and visitors. Its ground access services include a public bus service, a subway line, a streetcar line, and taxis. The buses run at 3-to-5-minute intervals, and take 20 to 25 minutes to reach the airport, making 16 stops en route. The fare is $0.12. The subway only takes 15 minutes, and makes 7 en route stops. Service frequency is identical to the buses. The fare is $0.10. The airport stop is 200 yards from the airline terminal however, whereas the bus stops at the door to the terminal.

The streetcar line follows a circuitous routing to the airport, and has a 25-minute travel time. Eleven en route stops are made. Service is operated at 5-to-10-minute intervals. The fare is only $0.08, but the airport stop is 1,000 yards from the airline passenger terminal.

There is no baggage handling on any of these airport transportation services. All operate through the principal center of the business district, and airline ticket offices are nearby.

Taxis make the airport trip in only 10 to 15 minutes, and serve the majority of CBD-airport traffic. The fare is $1.00. Automobiles appear to be the next most popular CBD-airport mode.

Boston-Logan International

Boston-Logan International Airport is approximately 4 miles east of Boston's Central Business District. In 1965, an average of about 7,500 airline passengers used the airport daily in each direction, and 3,500 people were employed there. Some 15,000 visitors also entered the airport on an average day, for a total of 26,000 airport trips in each direction in 1965.

Ground access is provided by limousine service, a subway-bus transfer combination, and taxicabs. The limousines run at 10-to-15-minute intervals all day, and travel times range from 30 to 45 minutes. The fare is $1.25. One en route stop is made. The Central Business District boarding stop is conveniently situated. Airline ticketing is available, and baggage can be checked through directly to destination city.

Rapid transit trains run from a Central Business District terminal with connections to other lines operating through the CBD. The trains operate to a station at the edge of the airport about 2/3 miles from the airline passenger terminal. Shuttle buses provide the connecting link, and make up to about a dozen stops within the overall terminal complex. Trains operate at 4-to-10-minute intervals; the connecting buses at 5-minute headways. Total travel time from the Government Center Station in the CBD takes up to 18 minutes. Three en route stops are made on the subway. The fare is $.20 for the subway and an additional $.10 for the bus. Baggage handling is provided only for the bus.

Estimates of the passenger characteristics on this subway-bus combination service vary. Response to the questionnaire indicates that 24 per cent of the airport travelers using the subway-bus route are airline passengers, 24 per cent employees, and 52 per cent for all others. An earlier estimate of summer of 1966 had placed employee traffic at 80 to 90 per cent of the total however.

The subway line to the airport is part of the regular Boston metropolitan transport network. The line carries about 1,000 travelers to the airport each day on the average, and this constitutes 5 per cent of the line's traffic. No estimate is available on the proportion of CBD-airport traffic that the subway serves.

Various efforts are being undertaken to make the subway-bus transfer route more attractive to airport passengers. Projects include new air conditioned cars for the airport line, a station rehabilitation and beautification program, and long-range studies of improving the service connections at the airport.

Taxis take 15 to 30 minutes to reach the airport, depending on congestion, and charge $2.30 for the CBD-airport trip.

Bremen

Bremen Airport is situated about 2 miles from the Central Business District of the city. In 1965, some 750 trips entered the airport every day, about one-half of them airline passengers. In 1967, the airline passenger traffic was an estimated 500 daily trips out of a total airport entry total of nearly 1,000 trips a day. Trips originating in the Central Business District account for about 42 to 43 per cent of the airport's traffic.

Tram and taxi service link the Central Business District with the airport. The tram apparently operates on roadways in the general vehicular traffic stream and makes 6 stops en route to the airport. Service is operated at 12-minute intervals, and the travel time is 15 minutes. The fare is $0.14. There is no baggage handling service. The tram line is conveniently situated in Bremen's CBD, and stops within 500 feet of the airline terminal building. The line serves about one-third of the CBD-airport traffic, and airport traffic accounts for about 20 per cent of the line's patronage.

Taxis also take about 15 minutes to reach the airport. The fare is $1.00. Taxis serve nearly one-quarter of the CBD-airport traffic. Automobiles serve a larger share of the market than the taxis, and slightly more than the tram services as well.

Brussels

Brussels Airport is 9 miles from the city's Central Business District. In 1966, it had 9,000 employees and served approximately 2,000 air passengers and 6,000 visitors in each direction daily, for a total traffic volume of 17,000 trips in each direction.

Ground transportation to the airport is provided by railroad, two common carrier bus services, and taxis. The rail service operates as a special "airport only" service from the CBD using regular intercity trackage for all but about 2 miles of its 10-mile run. An especially constructed spur line delivers passengers directly to the airline terminal building. (A 300-yard walk to the airline check-in area is apparently necessary, however.) Trains take 16 minutes, and operate on 19-minute headways during the peak period and 30-minute headways at all other times. No en route stops are made. An airline ticket counter is available in the CBD rail terminal, and luggage can be checked through directly to destination city. The one-way fare is $0.50.

Two bus services, both part of a regular intercity network, provide airport service too. One provides accommodation for luggage checking directly through to destination city; the other provides no baggage handling service at all. Both have 30-minute travel times, and make approximately 20 stops en route to the airport. The buses that provide baggage handling operate at 11-minute intervals during peak hours, and 18-minute intervals at other times. The other bus service operates to the airport at 60-minute intervals. The fare is $0.30 on both services. The service with the baggage handling accommodation stops about 100 yards from the airline terminal building.

Taxis reach the airport in 17 minutes from the Central Business District - about the same travel time as the railway. The fare is $4.20.

In 1966, the rail operation served more than 350 airline passenger trips in each direction every day. This amounts to about 20 per cent of all airline passenger traffic at Brussels Airport. In addition, employee and other traffic brings the daily airport rail service total up to 800 passengers in each direction. This amounts to a little less than 5 per cent of all traffic entering or leaving the airport on an average day. In total, airline passengers account for some 40 per cent of the rail traffic, employees 45 per cent and all others 15 per cent.

Cleveland Hopkins International

Cleveland Hopkins International Airport is situated 12 miles west of the Central Business District of Cleveland. In 1966, the airport served 25,500 daily trips in each direction, including 6,500 airline passengers, 2,500 employees, and 16,500 visitors. In 1968, it is expected that the total trips will increase to 32,000, including 8,000 airline passengers, 3,000 employees, and 21,000 visitors. It has been estimated that 16 per cent of the airport's airline passenger traffic originated in Cleveland's CBD on the basis of a special February 1965 engineering consultant's survey.

Available transportation to the airport includes limousines, buses, and taxis. Limousines serve major downtown hotels, making three stops. Service operates at 6-to-20-minute intervals depending on time of day. Travel times range from 40 minutes off-peak to 60 minutes or more during peak periods. The fare is $1.40.

Public bus service involves use of two regular transit routes with a passenger transfer along the way. Travel times range from 45 to 60 minutes depending on the time of day. Service is probably reasonably frequent. The total trip fare is $0.35.

Both of these operations are convenient to CBD airline ticket offices, particularly the limousine operation. There is no baggage handling on the public bus but baggage can be checked through to destination on the limousine.

Taxis make the trip in 35 to 45 minutes at a fare of $4.00-$5.00.

The above consultant's survey indicated that about one-half of the CBD originating airline passengers used the airport limousine service; the other half used automobiles and taxicabs in approximately a 3-to-2 ratio respectively. No information is available on other types of airport traffic and their present mode of travel between the CBD and the airport.

Construction is now underway on a $19,000,000, 3.9-mile extension of the city's existing 15-mile rail rapid transit system into the airport to within 150 feet of the airline terminal. The project is expected to be completed in late 1968. The estimated rapid transit running time is 22 minutes from the CBD including eight stops en route. Trains will operate at intervals of 10 minutes or less. The fare will be either $0.35 or $0.40. The new extension will include two intermediate stops. Along with the airport terminal, these three stations will serve 8,000 daily trips, according to the consultant's report. Some 3,300 of these will be new trips to the system; the remainder presently board at stations on the existing line. Of the 3,300 new trips, 840 are expected to be airport trips. Some 370 daily airport

trips are currently made on the Cleveland Transit System's bus services. With diversion of these to the rapid transit extension, 1,210 daily airport trips will be made in total on the rapid transit - composed of 710 airline passengers, 480 employees and 20 visitors. Based on these estimates, the rapid transit will serve about 5 per cent of the airport's airline passenger traffic. Including employee and visitor trips as well, the rapid transit will serve about 2 per cent of the airport's total traffic.

The airport trains will be air conditioned and will have racks for luggage. Discussion has been underway concerning the development of airline ticket counters and baggage check-in at the rapid transit line's CBD station, but costs are apparently a prohibitive factor.

The rapid transit's single CBD station is situated at the periphery of the Central Business District, and although at an important commercial focal point the station is one-half mile from the principal center of the business district. This can be a limiting factor, since a taxi or bus ride to the rapid transit station would be necessary in many cases.

Dusseldorf

Dusseldorf Airport is 5 miles from the city's Central Business District. In 1966, it served 10,400 trips in each direction consisting of 6,500 airline passengers, 2,100 employees, and 2,800 visitors. Some 12 per cent of the traffic originates in the Central Business District, and a total of 20 per cent of the airport traffic passes through Main Station, the principal CBD departure point for airport service. About 30 per cent of the total airport traffic originates within the Town of Dusseldorf, and nearly 75 per cent of all the airport traffic originates within about 30 miles of the town center. This includes the Towns of Cologne, Wuppertal, Dortmund, Bochan, Essen, and others.

On a regional basis, automobiles serve over 50 per cent of the airport traffic needs; taxis and buses handling the remainder. But in terms of CBD-airport trips alone, automobiles serve 45 per cent of the airport traffic, taxis 42 per cent, and two bus lines each about 6 per cent of the traffic.

Public transportation to the airport from the Central Business District is provided by two different types of bus services. The F-Bus is a special airport bus, with a 15-to-20-minute travel time to the airport, usually operating non-stop. Service operates at 30-minute intervals. There is baggage accommodation, but no special handling is provided. The fare is $0.37.

The public bus, Line No. 32, takes 20-25 minutes from the CBD to the airport, making 12 en route stops. Service operates at 15-minute intervals. The fare is $0.20. There is no baggage handling. Both bus routes operate to within 700 yards of the principal town center. The public bus makes five CBD stops, the F-Bus only one.

Because of the spread of traffic-generating areas over a broad area, Dusseldorf is looking to the development of an express train suburban railway system which would link all of the principal traffic areas. The airport would be included in this system. It is estimated that 35 per cent of all the airport passengers - including the CBD and all other origins and destinations - would utilize this rail network.

Hamburg

Hamburg Airport is approximately 7 miles from the city's Central Business District. In 1966, it served 4,600 airport travelers in each direction, 50 per cent of them from the CBD. Airline passengers accounted for 2,650 trips, employees 1,500 trips and all others 450 trips.

The CBD-airport ground access system consists of airport bus, public bus, tram, and subway-bus transfer routings. The airport bus service is the fastest route to the airport. With schedules every 12 to 20 minutes during the day, it makes the two-stop trip in 25 to 30 minutes, at a $0.50 fare. Some baggage handling accommodation is available.

The public bus service operates at 20-minute intervals, and makes the trip in 33 minutes. There are 14 stops en route. The fare is $0.20.

The tram line operates every 15 to 20 minutes. Its travel time, with 21 stops between the CBD and the airport, is slower than the other modes. Like the public bus, the tram line is part of a regular metropolitan service, and consequently it offers no baggage handling. The fare is $0.12.

On the subway-bus transfer routing, service is available at half-hours intervals. Travel time totals 34 minutes between the CBD and the airport. The fare is $0.17. There is no baggage handling.

All of the services described operate within one-quarter mile of the city's principal center, the airport bus being the most convenient. Airline ticket offices are situated in the general area.

At the airport, the tram and subway-bus transfer routing have stops within about 50 yards of the airline passenger building. The bus services provide more convenient delivery.

Automobiles handle nearly 50 per cent of the CBD-airport traffic, taxis about 20 per cent, and airport buses about 10 per cent. Collectively, the public bus, tram, and combination subway-bus services handle the remaining 20% of the traffic.

London-Gatwick

Gatwick Airport is some 25 miles south of London's Central Business District. About 4,000 employees work there throughout the year, but airline passenger and visitor traffic fluctuates seasonally as shown in the following tabulation of daily trips in each direction for 1965.

	Summer	Winter
Airport Passengers	4,000	800
Visitors and Spectators	1,400	280
Employees	4,000	4,000
Total	9,400	5,080

Gatwick projects a 4-to-5-fold increase in air passengers, and visitors and spectator traffic by 1975. Employees will increase to 16,000. The projected 1975 total airport traffic levels are estimated at 40,850 daily during the summer, and 24,100 daily during the winter.

The proportion of traffic from the Central Business District was 27 per cent of total airport traffic in 1965. This proportion is expected to increase to 57 per cent by 1975.

In subsequent information providing 1966 data, the extent of seasonal variations in traffic is further demonstrated, and additionally, the magnitude of peak day traffic flows in comparison to the average daily traffic levels is identified. On a peak season Saturday or Sunday for example, about 7,000 airline passengers departed from Gatwick, compared with 4,000 on a peak season weekday, and 1,000 on an off-peak season weekday.

Gatwick has a wide catchment area, with 38 per cent of the air passengers starting their journeys from outside the London Metropolitan region. Of the passengers originating in Central London, 80 to 90 per cent used public transport in the peak season, largely due to the fast rail connection subsequently described.

Business travel remained fairly constant throughout the year, but due to seasonal fluctuations in holiday travel, comprised one-third of total airline traffic on weekdays, but only 5 per cent of the total on peak season weekends. Some 60 per cent of the business travelers used public transport to get to Gatwick, as compared to 75 per cent of pleasure trips on weekdays, and 50 per cent on Sundays.

The 1966 information also identifies the magnitude of vehicular movements into and out of the airport. On peak season Sundays, the number of cars arriving at the main entrance averaged 350 an hour. On a peak season weekday nearly 4,000 vehicles entered the airport, of which 85 per cent were automobiles, about one-half of them used by employees. In total, nearly 80 per cent of all employee trips were made by private transport. The great majority of employees come from areas close to the airport.

The major method of ground access to the airport from the CBD is by direct rail service from Victoria Station. This service is operated by British Railways and is part of the Brighton Line intercity operation. The airport station is situated directly on the railroad mainline. Trains depart every fifteen minutes during most of the day. Some trains operate to the airport only; others stop there on longer intercity runs. The trip takes 40-45 minutes depending on the number of en route stops, which range from two to eight. The fare is $0.93. Air passengers on British United Airways (Britain's largest independent airline) can check in their baggage to destination city at Victoria Station and also purchase tickets there. Victoria Station is situated in London's Central Business District, but because of the area's expanse, some travelers have to go up to a few miles to reach the station. The station has direct subway and bus connections, however. At the airport, the airline passenger terminal building is immediately adjacent to the railroad station.

The rail travel time is considerably faster than the airport bus or taxi services which make the trip in 60 minutes during midday and evening hours, but take up to 90 minutes in the peak hours. The buses are used only for "package flights" or charters which include ground transportation to hotels as well as air travel.

The rail service is not only the obvious way to reach the airport from Central London, but is also a convenient way of getting to the airport from many places served by the Southern Region rail system especially places on or near the South Coast between Portsmouth and Eastbourne. On a peak season weekday about 40 per cent of all airline passengers use British Rail services to reach Gatwick, and on a peak Sunday about 45 per cent. Of those coming by rail, between 60 and 70 per cent travel via Victoria Station. Others come from the boroughs south of the Thames and the South Coast area.

According to the 1965 data, the rail line carried 600 to 2,150 daily passengers in each direction between the CBD and the airport, depending on the season. On the average, the rail line handles 72 per cent of the total airport traffic from the Central Business District. Automobile travel accounts for most of the remainder. The airport buses carry little traffic, and taxi patronage is negligible.

Airline passengers account for 70 per cent of the airport rail traffic, employees 10 per cent, and all others 20 per cent.

With the forecast growth of the airport, daily traffic on the railroad will range from a winter level of 10,400 trips in each direction to a summer level of 18,800 trips in each direction by 1975. Accordingly, plans are underway to expand and otherwise improve the service. New rail coaches are being introduced this year, and improved passenger facilities are under construction at Victoria and Gatwick. The long-term plan calls for an exclusive "airport only" service with trains operating at 10-minute intervals, having a rated capacity of 3,000 passengers per hour in each direction. Some discussion has also been underway concerning the feasibility of other airlines joining BUA at Victoria Station with ticket counters and baggage check-in accommodations. Available station space is quite restrictive, however, and a major reconstruction project might be necessary.

London-Heathrow

Heathrow is London's major international air terminal. It is located 18 miles northwest of the center of the city. Some 35,000 employees work there throughout the year, but airline passenger and visitor traffic fluctuates seasonally as shown in the following tabulations of daily trips in each direction for 1965.

	Summer	Winter
Air Passengers	20,500	9,200
Visitor and Spectators	7,100	3,200
Employees	35,000	35,000
Total	62,600	47,400

Airline passenger and visitor traffic is expected to increase by 2½ times by 1975. The employee population will increase to 47,000 for a total daily airport population of 115,850 during the summer and 78,050 during the winter, by 1975.

The proportion of traffic from the Central Business District was 29 per cent of total airport traffic in 1965. This proportion is expected to increase to 40 per cent by 1975.

In subsequent information providing 1966 data, the extent of seasonal variations in traffic is further demonstrated and additionally, the magnitude of peak day traffic flows in comparison to the average daily traffic levels is identified. On an August Sunday in the peak season for example, it is estimated that 73,000 people entered the airport's central terminal area. In marked contrast to the average daily traffic distribution reported for 1965, some 30 per cent were airline passengers, 38 per cent visitors with them, 21 per cent sightseers, and 11 per cent employees. Of the total, about 70 per cent arrived by automobile, and the remaining 30 per cent by bus. On a September weekday, when 59,000 people entered the airport's central area, the bus share of the market increased to 38 per cent.

Between 15 and 20 per cent of the departing air passengers surveyed transferred from other flights. Of the remainder, 40 per cent started their journey in Central London; another 30 per cent from the rest of London; and in total 80 per cent of the airline passenger traffic originating at Heathrow came from within a 40-mile radius of Central London. Of the passengers originating in Central London, 65 to 70 per cent used public transport in the peak season, and 55 to 60 per cent in the off-peak season, reflecting the decline in holiday travel. Only 20 per cent of all air passengers from Outer London used public transport.

Business travel remained fairly constant throughout the year, but due to seasonal fluctuations in holiday travel, comprised 60-70 per cent of total airline traffic in the off-peak season, but only 20-30 per cent of the total during the peak holiday season. Some 40 per cent of the business travelers used public transport to get to Heathrow, as compared to 55 per cent of holiday travelers on weekdays, and 45 per cent on Sundays.

1966 data indicates that employment at Heathrow has grown to 37,350, although only 23,750 enter the airport on an average day. Some two-thirds of this latter group come from car-owning households, and few of them take public transportation to work. Of those employees not owning automobiles, 57 per cent use public transportation. In total 76 per cent of all of the employee trips were made by private transport, 68 per cent by automobile. The peak hour of employee arrival is 8-9 AM, when 16 per cent of the central area employees arrive, as well as 33 per cent of the employees working in other areas of the airport. The proportion of total airport employment based in the central area was not reported.

The 1966 data also identifies the magnitude of vehicular movements into and out of the airport. On a peak season weekday more than 37,000 vehicles entered the airport, of which 27,000 were automobiles - 50 per cent of them used by employees and 27 per cent by airline passengers. Some 75 per cent of all of the vehicles entering the airport originated in Greater London, including 10 per cent from Central London and 40 per cent from the three principal districts near Heathrow. During the peak hour, nearly 4,700 vehicles entered the entire airport at all of its entrances. On a peak season weekday nearly 11,000 cars were parked on the airport at any one time, including some 2,850 cars in the central area and nearly 5,000 in the No. 1 maintenance area.

Confining the vehicular movement analysis to the central area alone, average daily flow varied from 24,000 on peak season weekdays to 19,000 on off-peak season weekdays. Slightly less than half of the peak season traffic was made up of airline passengers. Peak hour flow into the central area was 1,800 vehicles, of which only 6 per cent were airport coaches and buses; and the total peak hour movement in two directions amounted to 3,000 vehicles.

The airport is presently served by airport coaches (and private tour or charter buses) and a subway-bus transfer routing, and taxis and hire-car limousines.

The airport coaches operate according to flight schedule demand during midday and evening hours, and at 20-minute intervals during peak periods. Travel times range from 30 minutes off-peak, up to 45 minutes or more during peak hours. There are no en route stops. The fare is $0.84 or $1.05, depending on point of departure - Gloucester Road-West London Air Terminal (BEA) or Victoria (BOAC) respectively. Double-decker buses are used. Airline ticket offices are located at the terminals, and baggage can be checked through to destination city. Because of the expanse of the Central Business District, a trip of up to a few miles can be necessary for some travelers to reach the coach terminals.

The subway-bus routing involves use of the Underground from Central London to Hounslow West Terminal, a distance of 15 miles, where passengers can transfer to buses which operate 5 miles to the airport. The travel time for this service is generally 60 minutes throughout the day. Service intervals range from 3 minutes during peak periods to 15-to-20 minutes at other times of the day. The Underground makes 4 stops in the CBD, and comes within one-quarter mile of the principal centers. In addition, there are 11 en route stops on the combination service on the way to the airport. The total fare is $0.59. There is no baggage handling service.

Taxis and hire-car limousines make the trip in 30 to 60 minutes, depending on the time of day, similar to airport coaches. The taxi fare approximates $8.70. The hire-car can run up to $14.50.

Approximately 50 per cent of CBD-airport travelers presently use the airport coaches. About 10 per cent use subway-bus, other bus services, and taxis. Most of the remainder use private automobiles.

With the expected expansion of Heathrow's traffic, extension of British Railways' Southern Region services has been proposed by the British Airports Authority. The railway would operate from Victoria Station in Central London. The addition of this service to an expanding Gatwick service and also the proposed Channel Tunnel line service will strain the terminal's capability, and could result in a major reconstruction of the terminal. This could provide the opportunity for locating major airline ticketing and baggage handling services there. The airlines on the other hand, while supporting the railway extension, would prefer to see all baggage handling done at the airport, thus having the passengers handle their own luggage to and from the airport.

At the same time the London Transport Board is proposing an extension of the Underground's Piccadilly Line into the airport, citing the extensive distribution network throughout London provided by the Underground system.

In the British Airports Authority proposal, the railway trains would operate at 7-to-8-minute intervals, and the travel time would take 25 minutes. With 9-car trains each carrying 468 passengers and 20,000 pounds of baggage, an hourly passenger handling capacity of up to 3700 passengers in each direction would be provided (estimated 1975 peak hour demand is 2000 passengers). Provision of this CBD-airport train link would cost an estimated $40,000,000 and is expected to handle 50 per cent of the airline passengers at Heathrow. It is estimated that patronage on the airport rail link would be 70 per cent airline passengers, 10 per cent employees and 20 per cent others.

London Transport's Piccadilly Line (the Underground) could be extended into the airport from the existing Hounslow West Terminal, at a cost of $33,000,000. Trains could make the trip from the CBD in 39 minutes. Rated hourly capacity is 4,600 passengers in each direction, using 7-car trains seating 288. Headways would range from 4-to-8 minutes on the service. Fares are not expected to exceed the airport coach fares. No baggage accommodation would be provided.

If the two rail links should become operative, it is expected that they could collectively serve about 65 per cent of all CBD-airport trips in 1975, carrying 36,000 passengers in each direction on a summer day, and over 15,000 passengers in each direction on a winter day. The railroad service would undoubtedly handle mostly airline passengers, while the Underground would be most useful for employee trips, particularly since it operates across the city, making regular en route stops. Automobiles will carry about 30 per cent of the CBD-airport traffic, and buses and taxis the remainder of the traffic.

New York-Kennedy International

John F. Kennedy International Airport is situated 16 miles southeast of Manhattan's midtown Central Business District. In 1966, some 63,100 travelers in each direction entered or left the airport on an average day. Some 23 per cent of these were from Manhattan Island, primarily its Central Business District. Of the 63,100 total airport trips, 17,300 were airline passengers, 22,800 were visitors, and 23,000 were employees.

In 1975, current estimates indicate that 120,000 trips in each direction will be made into and out of the airport on an average day. Airline passengers will account for 37,000 of these, visitors 47,000, and employees 36,000. Manhattan is expected to generate 22 per cent of the total trips. Another 8 per cent of the trips are expected to pass through Manhattan on the way to the airport from points beyond.

Ground transportation between Manhattan and the airport consists of airport coach service, subway-bus transfer routings, taxis and helicopters. Airport coach service is scheduled to meet individual flights. Travel times from the Manhattan terminal - the East Side Airlines Terminal - to the airport typically take approximately 35 minutes during midday and evening periods, but en route freeway congestion lengthens peak hour travel times to 50-to-75 minutes typically. There are no en route stops. The fare is $2.00. Baggage can be checked through to destination city at the Manhattan terminal, and airline ticketing facilities are available there. The terminal is situated at the eastern periphery of midtown Manhattan, about a mile east of Times Square, and one-half mile east of Grand Central. It is within 1 or 2 miles of many of the principal midtown business centers, and up to 3 or 4 miles from the financial district (Wall Street). Midtown is the principal airport traffic-generating district. The downtown financial district is considerably less important in this respect.

Combination subway-bus routings involve use of either one of two subway lines from Manhattan to bus transfer points in the adjacent Borough of Queens. The two subway-bus transfer points are at different locations, but both are served by the same local bus route which operates into Kennedy Airport. (A few non-stop express buses operate from one of the transfer points into the airport via a connecting freeway, but this service is very limited.)

Service intervals generally range from 4-to-12 minutes, depending on the line and the time of day. Buses are scheduled at 5-to-10-minute headways as a rule. Travel times typically take 60-to-70 minutes, but can take longer depending on the Manhattan boarding point, the route chosen, and on waiting and transferring times en route.

One of the subway lines makes 8 stops in the Central Business District; the other 10 stops. This distribution system puts many major centers of the business district within one-quarter mile of the subway. The total number of en route stops between the CBD and the airport is largely a function of the route chosen and the number of stops made along the connecting bus line on the way to the airport. About 20 stops is a reasonable average, however. The fare is $0.40 total. There is no baggage handling. The bus stops at the airport range from 20-to-200 feet from the individual airline terminals situated in the central passenger terminal area.

Taxi service takes about 35 minutes between the Queens-Midtown Tunnel area near the East Side Airlines Terminal and the airport during midday and evening hours, but because of en route freeway congestion, peak hour travel times typically range from 50-to-75 minutes. The fare is about $6.00.

Helicopter service operates to Kennedy Airport from the Wall Street-financial district heliport, also used by the LaGuardia and Newark services. Service from atop the 59-story Pan Am Building at Grand Central in midtown was suspended in early 1968, but is expected to be resumed in the near future. Service from Wall Street operates at intervals averaging nearly 60 minutes. Non-stop travel time is 8 minutes from the Wall Street heliport. Most of the Wall Street flights make an en route stop at LaGuardia, however, producing a 17-minute flight time. Fares are $10.50 from the Wall Street heliport, but certain airlines offer reduced-rate tickets on connecting flights. There is baggage handling assistance at the heliport.

At the present time, 37 per cent of the airport travelers originating in Manhattan use automobiles, 23 per cent taxis, 20 per cent the airport coaches, 4 per cent the subway-bus combination routings, 2 per cent helicopters, and 14 per cent use airline company private cars and limos for flight crews.

In 1975, current estimates indicate that automobiles will control 42 per cent of the market, taxis 28 per cent, airport coaches 15 per cent, the subway-bus combination routings 4 per cent, helicopters 2 per cent, and airline company private cars and limos for flight crews, 9 per cent.

Various proposals have been made to improve public transportation access to Kennedy International Airport because of the defeating effects of peak hour congestion on the existing en route freeways, and no prospect for substantial improvements to the highway network in the connecting corridor. Many proposals have been judged physically impracticable or economically unfeasible, or both. Two plans are receiving careful study, however. One calls for development of a dual-capability vehicle which can operate with equal facility on both roads and railroad tracks. These vehicles would operate as conventional buses in the vicinity of the Manhattan terminal and in the less congested districts near the airport. For about one-half of the distance en route, however, retractable rail wheels would be lowered, and these combination rail-bus vehicles would operate on lightly-used railway trackage paralleling the congested freeways. A prototype vehicle has been assembled using a basic airport coach-intercity type bus, and its practicability and application are currently being evaluated in an extensive study program.

Another proposal would extend trackage from the Long Island Rail Road's mainline directly into the airport, a distance of a few miles. The railroad is a major suburban commuter carrier, and is currently undergoing an extensive modernization and expansion program. A link into Kennedy Airport is being physically and financially evaluated at the present time. Implementation of this rail extension plan, or the rail-bus plan, would substantially alter the aforementioned modal distribution forecast for 1975 by putting more passengers on public transportation.

In addition, major expansion of the airport now being planned, and associated highway and roadway development, will provide substantial increases in the vehicular capacities of the road network within the airport itself to meet the increasing general traffic demand.

New York-LaGuardia

LaGuardia Airport is situated 7 miles northeast of Manhattan's midtown Central Business District. In 1966, some 15,000 travelers in each direction entered or left the airport on an average day. Some 37 per cent of these were from Manhattan Island, primarily its Central Business District. Of the 15,000 total airport trips, 7,700 were airline passengers, 4,000 were visitors, and 3,300 were employees.

In 1975, current estimates indicate that 40,000 trips in each direction will be made into and out of the airport on an average day. Airline passengers will account for 22,000 of these, visitors 11,000 and employees 7,000. Manhattan is expected to generate 35 per cent of the total trips. Another 5 per cent of the trips are expected to pass through Manhattan on the way to the airport from points beyond.

Ground transportation between Manhattan and the airport consists of airport coach service, subway-bus transfer routings, taxis, and helicopters. Airport coach service from the Manhattan terminal - the East Side Airlines Terminal - generally operates at 10-to-15-minute intervals, and makes the trip to the airport in 20 minutes during midday and evening periods, and in 35-to-40 minutes during the peak hours. There are no en route stops. The fare is $1.50. Baggage can be checked through to destination city at the Manhattan terminal, and airline ticketing facilities are available there. The terminal is situated at the eastern periphery of midtown Manhattan, about a mile east of Times Square, and one-half mile east of Grand Central. It is within 1 or 2 miles of many of the principal midtown business centers, and up to 3 or 4 miles from the financial district (Wall Street). Midtown is the principal airport traffic-generating district. The downtown financial district is considerably less important in this respect.

Combination subway-bus routings involve use of either one of two subway lines from Manhattan to the Jackson Heights district in the adjacent Borough of Queens. At this point passenger transfer can be made to a local bus route which operates into LaGuardia Airport. Service intervals generally range from 4-to-12 minutes on the subway and 5-to-10 minutes on the bus service. Travel times are typically 40-to-45 minutes, but can vary considerably depending on Manhattan boarding point and on waiting and transferring times en route.

One of the subway lines makes 3 stops in the Central Business District; the other 10 stops. This distribution system puts many major centers of the business district within one-quarter mile of the subway. The total number of en route stops between the CBD and the airport is largely a function of the number of stops made along the connecting bus route on the way to the airport. About 15 stops in total is a reasonable average however. The fare is $0.40. There is no baggage handling. The bus stops immediately at the airline passenger terminal building.

Taxi service takes about 20 minutes between the Queens-Midtown Tunnel area near the East Side Airlines Terminal and the airport during midday and evening hours, and about 35-to-40 minutes during peak hours. The fare is about $3.50.

Helicopter service operates from the financial district to LaGuardia Airport. Service generally operates at intervals averaging nearly 60 minutes. Travel time is only 6 minutes, but the Manhattan heliport is 3 to 4 miles distant from the important midtown Manhattan airport traffic-generating districts.. The fare is $7.35. There is baggage handling assistance.

At the present time, 57 per cent of the airport travelers originating in Manhattan use taxis, 25 per cent automobiles, 14 per cent the airport coaches, and 4 per cent the subway-bus combination routing. Helicopter traffic is not reported, but it is quite small.

In 1975, current estimates indicate that taxis will control 50 per cent of the market, automobiles 27 per cent, airport coaches 19 per cent, and the subway-bus combination routing 4 per cent. Helicopter patronage has not been included in the estimate.

Proposals for extending rail rapid transit service into the airport have been made, but would be quite costly, and the schemes show no significant travel time advantage. Reconstruction of a freeway interchange in the Borough of Queens on the main airport route, now underway with completion scheduled for 1970, will eliminate traffic tie-ups and reduce peak hour travel times to the airport by an estimated 10 minutes at minimum. This will essentially produce travel times then equivalent to the fast existing, midday and evening travel times. It will make LaGuardia easily accessible at all hours.

New York-Newark

Newark Airport is situated 13 miles southwest of Manhattan's midtown Central Business District. In 1966, some 13,600 travelers in each direction entered or left the airport on an average day. Some 18 per cent of these were from Manhattan Island, primarily its Central Business District. Of the 13,600 total airport trips, 6,100 were airline passengers, 4,200 were visitors, and 3,300 were employees.

The airport is presently being redeveloped, and with this expansion it is expected that some 37,000 trips in each direction will be made into and out of the airport on an average day in 1975, according to current estimates. Airline passengers will account for 18,000 of these, visitors 12,000, and employees 7,000. Manhattan is expected to generate 20 per cent of the total trips. Another 7 per cent of the trips are expected to pass through Manhattan on the way to the airport from points beyond.

Ground transportation between Manhattan and the airport consists of airport coach service, public bus service, taxis, and helicopters. Airport coach service from the Manhattan terminal--the West Side Airlines Terminal--generally operates at 15-minute intervals, and makes the trip in about 25 minutes in off-peak hours and generally 30-to-35 minutes in peak hours. There are no en route stops. The fare is $1.50. Baggage can be checked through to destination city at the Manhattan terminal, and airline ticketing facilities are available there. The terminal is situated at the western periphery of midtown Manhattan, and is about one-quarter mile from Times Square, but is 1 to 2 miles from many of the principal midtown business centers, and up to 4 miles from the financial district (Wall Street).

Public bus service is scheduled at 6-to-15-minute intervals throughout the day. Travel times are about the same as the airport coach service. There are no en route stops. The fare is $0.50. There is no baggage handling or airline ticketing facilities situated immediately at the Port Authority Bus Terminal from which these buses operate. This terminal is about 300 yards closer to the business district than the airport coach service terminal, and is more conveniently situated to the city's subway system. At the airport the public bus stops about 50 yards from the airline passenger terminal's main entrance.

Taxi service takes about 25-to-35 minutes between the Lincoln Tunnel area near the West Side Airlines Terminal and the airport, depending upon the time of the day. The minimum fare is $9.80, a rate unusually high for the distance involved since it involves interstate travel between the States of New York and New Jersey.

Helicopter service operates from the financial district to Newark Airport. Service generally operates at intervals ranging from 30-to-60 minutes. Travel time is only 6 minutes, but the Manhattan heliport is 3 to 4 miles distant from the important mid-town Manhattan airport traffic generating districts. The fare is $10.50. There is baggage handling assistance.

At the present time, 51 per cent of the airport travelers originating in Manhattan use the airport coach service, 16 per cent the public bus, 19 per cent automobiles, 7 per cent taxis, and 7 per cent airline company private cars and limos for flight crews. Helicopter patronage is small.

In 1975, current estimates indicate that airport coaches will control 36 per cent of this market, public buses 16 per cent, automobiles 27 per cent, taxis 13 per cent, and helicopter and airline company private cars and limos for flight crews, 8 per cent.

Various proposals for extending rapid transit or railroad service from Manhattan into Newark Airport have been made. All would involve heavy capital expenditure and would offer little, if any, travel time advantage compared to the highway services. Expansion of the major highway link between Manhattan and Newark Airport--the New Jersey Turnpike--and reconstruction of the airport and associated highway and roadway development now underway, will provide substantial additional vehicular capacity for the foreseeable future.

Newark's Central Business District is situated a couple of miles northwest of the airport. The CBD generates little airport traffic, and taxis and a public bus service provide the necessary connecting transportation.

Paris-LeBourget

LeBourget is situated 11 miles north of the Central Business District of Paris. This airport is much smaller than Orly Airport. In 1966, it served 9,500 daily trips in each direction, consisting of 7,000 employees, 2,000 airline passengers, and a few visitors. Some 17 per cent of the total airport traffic originated in the Central Business District. The airport is expected to be closed in 1975; and air traffic will be diverted to Paris Nord Airport, under construction approximately 7 miles northeast of LeBourget.

Passengers traveling between the CBD and LeBourget have their choice of an airport bus, a metro (subway)-connecting bus service, or taxis. During the peak period, the airport buses operate at 10-to-12-minute intervals, and take one hour for the trip. During midday and evening hours, buses operate on 15-minute headways and take 45 minutes for the trip to the airport. The fare is $0.70. Buses make one stop en route to the airport. Baggage handling assistance is available. Airline ticket offices are located at or near the downtown terminal. Their terminal is within a mile or two of most parts of the Paris CBD.

The metro-bus combination involves use of the metro from the Central Business District to an en route transfer point, and use of a connecting bus from there into the airport. During off-peak hours, the trip takes 55 minutes; in peak hours, 70 minutes. Numerous en route stops are made. The fare is $0.82. There is no baggage handling. The metro makes several stops in the Central Business District, and has stations within one-quarter mile of the principal centers. At the airport, the connecting bus apparently stops right at the airline passenger terminal, as the special airport buses do.

Taxis make the airport trip in 30-to-50 minutes, depending on time of day. The fare is $1.83.

In terms of total CBD-airport traffic, nearly 50 per cent use the airport bus service. Another 30 per cent use automobiles, and 20 per cent taxis. Patronage on the metro-bus combination service is negligible.

It is reported that the airport bus service carries 40 per cent of the airline passengers. Autos carry 15 per cent of the passengers, and some visitors and employees. Taxis carry 15 per cent of the passengers and a few visitors. Other passenger trips are not accounted for.

Paris-Nord

Paris Nord Airport is to be opened to traffic in 1972. It is 7 miles northeast of LeBourget Airport and 17 miles from Paris. LeBourget is expected to be closed in 1975 and Orly will begin diverting flights to Paris Nord shortly thereafter as well.

By 1985, thirteen years after opening, it is expected that the airport will handle 86,000 trips in each direction on an average day, 43 per cent of them from the Central Business District of Paris. Of the total 86,000 trips, 33,000 will consist of airline passengers and 50,000 will be employees. Only a minimal visitor count is forecasted.

Transportation between the Central Business District and the airport will be provided by special airport bus service, metro (subway) service with a shuttle bus connection on the airport to the airline passenger terminal area, helicopter service, and taxis.

The airport bus service will operate at 5-to-10-minute intervals, and the travel time will range from 30 to 60 minutes dpending on time of day. The fare schedule has not been established, but some sort of baggage handling assistance will be available. Two en route stops will be made. The CBD terminal will be within 1 to 2 miles of most parts of the business district. Airline ticketing facilities will be situated at the terminal.

The metro line will be completed by 1980. Running 17 miles, it will stop about 1,000 yards from the major passenger terminals, where a passenger transfer can be made to a shuttle bus. The travel time is estimated at 40 minutes, including the bus connection, any time of the day. Several en route stops will be made. Service will be provided at 5-to-10-minute intervals. The fare schedule has not been established. There will be no baggage accommodation. Several stops will be made in the Central Business District, and the stations will be within one-quarter mile of the principal centers.

The proposed helicopter service will operate at 15-minute peak hour intervals. The trip between the CBD terminal and the airport will take 15 minutes with one en route stop. The CBD heliport will be within 3 miles of all parts of the business district. Baggage handling assistance will be available. The fare schedule has not yet been established. Service is expected to begin in 1975.

The taxi trip will take 25 to 50 minutes, depending on time ofday. The fare schedule has not yet been established.

In 1985, it is estimated that automobiles will handle 64 per cent of the total CBD-airport traffic. Some 18 per cent of the traffic will use the metro-bus combination, 13 per cent taxis, 4 per cent the special airport bus, and 1 per cent helicopters. On the metro, the CBD segment of the traffic will consist of 60 per cent airline passengers, 15 per cent employees, and 25 per cent visitors.

A report describing the development and design of Paris-Nord estimates that of the total airline passenger traffic at the airport - CBD and all other origins-destinations - 60 per cent will use private cars (1/3 accompanied, 1/3 hired, and 1/3 non-accompanied), 20 per cent taxis, and 20 per cent public transport. Similarly for all the employees at the airport - CBD and all other - 67 per cent will use private cars and remaining public transport. It is estimated that extension of an underground line of the Regional Express Network into the airport with fast train connections throughout the Paris region could substantially alter these estimated modal splits.

With the metro-connecting bus service described previously, 22 per cent of all airport traffic originating in the CBD and all other points would utilize this specific public transport. One-third of this metro traffic would originate in the CBD and the division of CBD passenger types on this service has been heretofore described. For all the airport traffic on the metro - CBD and other - the division of traffic will be substantially different from the CBD-only group. The total metro-airport patronage will consist of 25 per cent airline passengers, 65 per cent employees, and 10 per cent all others. This airport traffic will constitute 10 per cent of all the patronage on this metro line.

Paris-Orly

Orly is the major international airport of Paris at the present time. It is located about 9 miles south of the Central Business District. Some 20,000 employees worked there in 1966, and a daily average of 8,000 air passengers entered the airport that year. Total daily traffic totaled 31,000 in each direction, and 21 per cent of these originated in the Central Business District.

Public transportation from the CBD to the airport consists of a special airport bus, a subway-bus transfer combination routing and taxi service. The airport bus service operates at 8-to-10-minute intervals during peak hours, and at 15-minute headways at other times. Travel times range from 30 to 40 minutes, depending on time of day. Up to 2 en route stops are made. The fare is $0.70. Some sort of baggage handling service is available, and there are airline ticketing facilities at or near the CBD terminal. The terminal is within a mile or two of most of the principal business area centers.

The subway-bus transfer routing involves a passenger transfer from the metro to a special airport bus en route. Travel time takes 40 to 50 minutes depending on time of day. Several en route stops are made on the metro, but the connecting bus is a non-stop express to the airport. The total fare is $0.82. There is no baggage handling. The metro makes several stops in the Central Business District, and has stations within one-quarter mile of the principal centers. At the airport, the connecting bus apparently stops right at the airline passenger terminal, as the special airport buses do.

Taxis make the trip in 30 to 45 minutes, and charge $2.40.

In terms of total CBD-airport traffic, 50 per cent use the airport bus service. Another 28 per cent use automobiles, and 20 per cent taxis. The remaining 2 per cent use the metro-bus combination service.

It is reported that the airport bus service carries 40 per cent of the airline passengers. Autos carry 15 per cent of the passengers, and some visitors and employees. Taxis carry 15 per cent of the passengers and a few visitors. The metro-bus combination carries a few employees and visitors. Other passenger trips are not accounted for.

Two metro links to the airport are contemplated for some time in the future. One would be a special line from the city directly to the airport with intermediate stops. The other would have an airport station on a line of a new suburban express metro network linking the city with outlying districts.

It is reported that visitor traffic now amounts to 30,000 on a peak summer Sunday. (By comparison, the number of visitors averaged 3,000 per day in 1966). The Autoroute du Sud, the six-lane freeway linking the airport with Paris, is now heavily congested at times. More traffic is expected on the expressway when Les Halles, the city's market, shifts to a location near Orly in 1968.

Rome-Fiumicino

Rome-Fiumicino Airport is 17 miles from the Central Business District of Rome. In 1966, it was used daily by 3,400 airline passengers and 3,900 visitors in each direction. In addition, 4,400 employees worked there, for a total daily flow of 11,700 trips in each direction. Some 22 per cent of these trips originated in the Central Business District.

Ground transportation from the CBD to the airport is provided by airport coach, public buses, a railroad, and taxis. The airport coach operates at 3-to-8-minute intervals and makes the airport trip in 40 to 60 minutes depending on time of day. Two en route stops are made. The fare is $0.64. Some sort of baggage handling assistance is available. There are 2 CBD stops, and they are within 3 miles of the principal business centers. The airport stop is 200 yards from the airline passenger terminal building.

No information is available concerning public bus service to the airport except that it carries very few passengers - 18 each way per day.

The railroad trip takes 35 minutes. Trains run every 20 minutes in the peak periods and every 30 minutes off-peak. The rail link is part of an intercity service making six stops between the CBD and the airport. No baggage handling is provided and the airport station is 1.2 miles from the airline passenger terminal. There is no connecting bus service. The fare is $0.40. Patronage from the CBD to the airport is negligible - 12 trips a day in each direction.

Although no travel time information is available, it is known that the majority of people from the CBD - nearly 80 per cent of them - use automobile travel to the airport. Some 8 per cent use the airport coach, and 4 per cent use taxis. The remainder use the public bus and railroad services, and "other modes."

No specific plans exist for improving or altering access to the airport.

San Francisco International

San Francisco International Airport is 15 miles south of San Francisco's Central Business District. According to information reported in response to the survey, the airport served about 122,000 daily trips in each direction in 1966. Of these, 24,600 were airline passengers, 24,000 were employees, and 73,800 were visitors.

Access between the CBD and the airport is provided by a limo-coach service, a public bus service, a helicopter service, and taxis. The limo-coach service operates at 5-to-10-minute intervals and takes 30 minutes to make the CBD-airport trip in midday and evening hours, and up to 60 minutes in peak hours. There are no en route stops. The fare is $1.10, and baggage can be checked through to destination city. Airline ticketing facilities are available at the CBD terminal.

The public bus has the same travel time as the limo-coach, 30 to 60 minutes, but makes eight stops between the CBD and the airport. It, too, operates every 5 minutes in the peak hours and every 10 minutes during the midday and the evening. The fare is $0.70. There is no baggage handling service. At the airport, the bus stops about 100 yards from the airline passenger terminals on the average. (The limo-coach stops at the immediate building entrances.)

No information has been reported on the helicopter and taxi services, or on passenger modal choices. It is assumed that travel time via taxi are comparable to the airport limo-coach service, however.

A multi-sponsor test of the feasibility of using ground effect machines for airport access across San Francisco Bay was completed in 1966.

Looking to the future, a Bay Area Rapid Transit system is now under construction to serve the regional travel needs of the San Francisco-Oakland metropolitan area, and is expected to start operations in 1969-70. There has been some discussion of eventually extending fast train service to San Francisco International Airport.

Tokyo-International (Haneda)

Japan's major international airport is situated along Tokyo Bay 9 miles south of Tokyo's Central Business District. In 1965, 25,000 daily trips in each direction were made into and out of the airport, 37 per cent of them from the Central Business District. The total traffic consisted of 5,500 airline passenger trips, 10,000 employee trips, and 10,000 visitor trips.

From the CBD, airport-bound passengers have seven types of public transportation available to them. These include a monorail, a tram (the Keihin Express) with connecting bus at the airport, another tram (National Railway) with en route bus transfer, an airline bus, a limousine, a scheduled (or public) bus, and taxis.

The monorail operates at 10-to-12-minute intervals, and has a 15-minute travel time. Two en route stops are made--Oi Racetrack near the midpoint of the route and a stop at the maintenance area at the airport. The fare is now $0.33 for airline passengers and $0.42 for all others. There is no baggage handling at present. The monorail runs from Hamamatsu-cho, a station on the National Railway, about 2 miles from the principal center of the CBD, directly into the airline passenger terminal.

The Keihin Express routing is a combination train-tram-bus routing utilizing regular metropolitan transport service. The airport trip involves use of National Railway trains from Tokyo's CBD, 4 miles to Shinagawa Station where a transfer is made to the Keihin tram line which goes to Keihin-Kamata. Here another transfer is made to a shuttle train to Hanedakuko on the airport boundary, 1000 yards from the airline passenger terminal. A shuttle bus provides the connecting link. Service is provided at 6-to-10-minute intervals. Total travel time is 30 minutes, and there are 6 en route stops. The fare is $0.20. There is no baggage handling.

The National Railway itself also operates a train-bus combination routing to the airport as part of the city's metropolitan transport services. This service requires an en route passenger transfer too. The line runs from Tokyo's CBD to Kamata parallel to the Keihin Line. At Kamata, passengers transfer to a bus to the airport. Service operates at 3-to-12-minute intervals, but takes a lengthy 50 to 60 minutes. The train makes 6 stops in the CBD; then there are 8 en route stops to Kamata, and an additional 12 on the connecting bus. The fare is $0.30. There is no baggage handling.

The airline bus operates at 7-minute peak hour intervals, but at 60-minute intervals during midday and evening periods. Travel times range from 25 to 30 minutes. No en route stops are made. The fare is $0.33. Some baggage handling assistance is provided. The service operates directly from the principal center of the business district to the airport passenger terminal building at the airport.

To the extent that information has been provided, the limousine service appears identical to the airline bus service. The fare is $1.30, however.

The scheduled public bus runs at 20-to-30-minute intervals directly from the principal center of Tokyo's CBD to the airline passenger terminal at the airport in 35 to 45 minutes depending on the time of the day. Four stops are made within the CBD; another 8 en route to the airport. The fare is $0.20. There is no baggage handling.

Taxi trips take 20 to 25 minutes. The fare is $2.75.

According to the information reported, the monorail is carrying about 36 per cent of the CBD-airport traffic, the two tram lines (Keihin Express and National Railway) collectively carry 16 per cent of the traffic, automobiles and taxis each accommodate another 16 per cent, the scheduled (public) bus 12 per cent, and the airline bus and limousine collectively handle 4 per cent of the traffic.

The Keihin Express is an important employee carrier--72 per cent of its airport traffic consisting of airport workers. The remainder are classified as "All Others." No air passengers are involved. In total, airport traffic accounts for 2 per cent of the total traffic carried on the Keihin line.

The monorail installation and service has attracted considerable attention, and some further comment is appropriate. The line was constructed at a cost of $54 million, and opened in September 1964. Even though it appears to be the single most popular airport mode from the CBD, with a reported 36 per cent share of the market (average of 7,500 daily passengers on the monorail), many of these passengers are apparently not actually airport-oriented. Oi Racetrack is an important monorail traffic generator too. Of the total monorail passenger volume, 14 per cent are airline passengers, 6 per cent are airport employees, 60 per cent are airport visitors and 20 per cent are race track patrons.

The monorail has never attracted the 10 to 14 million annual passengers originally estimated for it. The 1967 patronage was 5.5 passengers. The monorail is remote from principal traffic generating areas in Tokyo, its CBD terminal being 2 miles from the principal center of the business district. In addition, CBD-airport automobile, taxi, airline bus, and limousine travel times on the parallel freeway match the monorail's running time, considering the latter's remote CBD location and the time necessary to get there.

The line's single-track stub terminal at Hamamatsu-cho (on the top floor of a five-story building) and a single-track section at the airport effectively limits passenger handling capacity to 2,000 passengers per hour in each direction with present equipment. Expansion of the equipment fleet with present fixed facilities would provide a rated

capacity of 4,500 passengers per hour in each direction at five-minute headways. To our knowledge the maximum peak hour demand has not exceeded 1,700 passengers to date.

Improved physical connections for passengers transferring from the National Railway to the monorail at Hamamatsu-cho were recently provided. Information available indicate that 75 per cent of the monorail patrons transfer from National Railway trains. It is understood that a November 1966 fare decrease and other improvements have resulted in a doubling of patronage on the monorail.

Plans are underway to develop special baggage handling facilities on the monorail. There is some discussion of extending the line to a proposed Shimbashi Terminal in downtown Tokyo, or around the southern fringe of Tokyo's CBD into nearby suburban districts west of the business center. Other extensions have been proposed too.

In other airport access matters at Tokyo, it has been reported that the Japanese Transport Ministry has completed plans to construct a new high-speed railway line connecting the Japanese National Railways' Narita Station with Tokyo's new international airport now under construction. Completion is set for Spring 1971.

Vienna-Schwechat

Vienna's Airport is 12 miles from the city's Central Business District. In 1965, 4,600 daily trips were made into and out of the airport on an average day. Some 2,100 were airline passengers, 500 were employees, and 2,000 were visitors.

Ground access is provided by airport bus and inter-city railroad operations, and taxis. The bus takes 25 to 30 minutes for the CBD-airport trip. There are no en route stops. Buses leave the terminal every 30 minutes. The fare is $0.55. While passengers can purchase plane tickets at the CBD terminal, there are no baggage handling accommodations. The CBD terminal is situated about 1.2 miles from the principal center of the business district.

The train takes 40 minutes from the CBD to the airport, making 7 en route stops. Operations are scheduled at intervals of an hour or more. It is part of a regular intercity service. The fare is $0.28. There is no baggage handling. The CBD railroad terminal is ½-mile from the principal center of the business district. The train makes 3 stops in the CBD. The railroad station closest to the airport is 800 yards from the airline passenger terminal, however; the bus, on the other hand, provides direct service.

No information has been reported on taxi services or passenger modal splits, except that the railroad carries less than 1 per cent of the CBD airline passenger traffic.

The airport operator reports that a new city air terminal and railway station will be constructed, and that the present single track line will have a second track added.

Washington-Dulles International

Dulles International Airport is situated 26 miles from Washington's Central Business District. In 1966, it was used by an average of 1,750 daily passengers in each direction and it employs about 1,300 workers.

Ground access from the CBD to Dulles is provided by airport coaches and limousines, public buses, and taxis. Airport coaches and limousines are scheduled to connect with specific flights, and take 35 to 45 minutes for the trip depending on time of day. Up to 4 en route stops are made between the airport and CBD terminal, depending on local passenger destinations. The fare is $2.50. Baggage checking through to destination city is available at the CBD terminal, and airline ticketing facilities are located there too. The terminal is situated within ½-mile of the principal center of the business district. Buses and limousines utilize the 14-mile Dulles Access Road into the airport. This expressway is for airport traffic only, and is used by automobiles, taxis, and public buses too.

The public bus makes an airport stop as part of a regular intercity service operation. It takes 70 to 90 minutes, and charges a $1.50 fare. The CBD terminal is about 1 mile from the principal center of the business district. The buses utilize the Dulles Access Road for 12 miles of its 14-mile length.

Taxis take 35 to 45 minutes for the airport trip, and charge a $13.00 fare.

The Dulles Access Road is a unique approach to airport access. Plans are underway to extend it an additional 2.4 miles toward the city to a major highway connection, Route 66. This will reduce both travel time and distance. Beyond this, the possible development of a high-speed railroad link from the CBD to Dulles International to encourage more use of the airport is being studied.

National Airport, situated near the CBD, is infinitely more popular at the present time.

Zurich-Kloten

Zurich-Kloten is situated 6 miles from the city's Central Business District. In 1966, 12,000 daily person-trips in each direction entered or left the airport. Of this total, nearly 3,000 were airline passengers. There were an equal number of visitors, and 6,000 employees as well. By 1975, it is expected that the daily total number of entering or departing trips will rise to 21,100, consisting of 7,600 airline passengers, 4,000 visitors, and 9,500 employees.

Access from the Central Business District is provided by an airport coach, public bus, train service, and taxis. The airport coach operates at 10-to-15-minute intervals, and takes 15 to 35 minutes to reach the airport, depending on time of day. There are no en route stops. The fare is $0.70. Some baggage handling assistance is available, and airline ticketing facilities are available at the CBD terminal.

Swissair, operator of the coach service, also provides employee bus services between the CBD and the airport during rush hours.

The public bus runs at 10-minute intervals during peak hours, and at 30-minute intervals at other times. Travel time is reported at a constant 25 minutes, regardless of time of day. The bus service is part of a regular metropolitan operation, and makes 9 stops en route to the airport. The fare is $0.20. There is no baggage handling assistance. The airport stops are 100 yards from the airline terminal building.

Apparently there is also a tram-bus combination routing, with a passenger transfer required at Seebach. No further information has been reported on this service however, and it is presumed that it has only a negligible role in airport access.

The railroad's airport station is 1.2 miles from the airline passenger terminal, and is only of limited use for airport employees. Swissair's new administration building is within walking distance of the railroad station, and hence railroad utilization might improve somewhat. The railroad fare is $0.33 second class and $0.47 for first class.

The modal split of CBD-airport trips has not been reported, but the modal distribution of total airport trips has been provided in considerable detail, as follows. Some 53 per cent of airline passengers use the airport coach service, 30 per cent automobiles, 15 per cent taxis, and 2 per cent public bus service.

For employees and all others, 41 per cent drive to work, 18 per cent use the public bus, 15 per cent the Swissair coaches or employee buses, 6 per cent use the railroad service, and 20 per cent use motorcycles, bicycles, or walk.

A rapid transit train connection is planned, operating partly underground from the Main Station in the CBD to the airline terminal building. An underground terminal at the airport for the subway line was already completed in 1966 in connection with a road building project. A completely new city-to-airport road connection will be completed in 10 years.

In 1975, it is expected that 30 per cent of the total daily airport traffic will use automobiles, 20 per cent will use the railroad and the projected subway services, another 20 per cent will use the coach-limo, 15 per cent the public bus, 5 per cent taxis, and 10 per cent will use motorcycles, bicycles, or walk.

APPENDIX C

AVAILABILITY AND CHARACTERISTICS OF SHUTTLE SERVICE EQUIPMENT

Excerpted from *The Lab is the City, A Proposal to Develop a Central Area Distribution System* by the Boston Redevelopment Authority and including a brief statement on the MIT Project METRAN

AVAILABILITY AND CHARACTERISTICS OF EQUIPMENT

Perhaps the most difficult step in an evolutionary process is that of properly specifying and obtaining the next generation of equipment. The enormous costs of conceiving, planning, engineering and building complex transportation devices sets severe limitations on this activity. Even when unsatisfied needs are adequately described, it is most difficult to translate them into workable solutions. Unfortunately, obtaining an accurate description of needs themselves is often dependent on operation of some kind of equipment that at least approximates the ultimate solution. This situation requires that a search for immediate action possibilities be tied to the relative availability of potential types of equipment. Each type must be considered not only from the point of view of what it is intended to do but also in consideration of whether it can be obtained so it can do it. This in turn is related to the amount of time and funds one visualizes to be available for expenditure.

Moving Belts

Conveyor belts for the movement of goods and raw materials have been commonplace for many years. The application of this relatively simple device to the movement of people is comparatively recent. The first installment of a moving sidewalk was just 16 years ago, and at the present time, no more than 200 of those units are in operation throughout the world. This is rather surprising considering the advantages inherent to this form of mass transportation. No other presently used public transportation service has the advantage of continuous service; very few have automatic operation. The walks, like escalators, can be made to be reversible, allowing some flexibility to handle peaks. Other advantages include low operating cost, high capacity, and safety. Inquiries on this latter, very important aspect, revealed an almost unblemished record of non-injury operation of existing walks used by the public.

The prime disadvantage to moving sidewalks is their relatively low speed of travel. National codes limit them to 3 feet per second which is only 75% of normal walking speed, and most installations are operated below code allowance. This disadvantage can be offset somewhat by installing belts of sufficient width to permit walking with the belt, and passing others along the way. This is an entirely acceptable procedure for most pedestrians. It has the net effort of cutting the distance actually walked to 57% of the true distance and the time to 57% of the normal walking time. Those persons to whom time is relatively unimportant can make the trip without walking at all. In addition, it is possible to walk part of the way and rest part of the way without losing all the time of the rest period.

The speed of moving belts is controlled by the ability of persons to enter and leave at the end points and cannot be substantially changed. Some studies have been made of possible acceleration to greater speeds along the mid-portions. Eventually, the technical problems of the procedure may be solved.

All the above suggests that moving belts can be used in particular situations that likely would involve walking in any event. The relative availability and cost of other modes of travel would have a bearing on the practical usable distance. Entry and exit points by means of short belts adjoining the longer through belt at selected points would also make the service available for numerous short trips.

The capital cost of a moving sidewalk, including engineering and installation, but not structure, varies from $300 to $400 per foot of length depending on width, length and speed.

A unit occupies a depth of about four feet, measured from the bottom of the drive mechanism to the top of the belt. An upper limit on the degree of incline is 15°. (27% grade)

The oldest moving sidewalks under public ownership are in Tacoma. They are over five years old, and the initial insurance premium was based upon experience in the escalator field. The current premium is half of the original, and no accidents have been reported.

The approximate capacity of a moving sidewalk in widths over 25" can be expressed as 2000 persons per hour per foot of width. Commonly, installations have widths of 3 to 4 feet, with corresponding capacity of 7,000 persons per hour, depending on speed.

The annual power cost has been estimated to be $1.00/year per 1000 passengers per hour of capacity per foot of length.

These data suggest that a non-revenue installation in an area of high pedestrian concentration may well be a proper solution. In particular if the total distance to be traversed is greater than normal walking distance but less than a distance which would provide toleration of waiting time and extra fares, it may be the proper equipment. It has the immediate advantage of full development and availability for use.

Minibus

The minibus offers somewhat greater speed and significantly more flexibility over intermediate distances than the moving sidewalk, but has a number of serious disadvantages. The major disadvantage is the high operating cost, a significant portion of which is attributable to the need for a driver. Additional disadvantages include air pollution, waiting time at stops, multi-stop operation (typically), traffic congestion and traffic hazards.

The term "Minibus" was first coined in 1963 by a Washington (D.C.) Evening Star reporter to describe the "Trackless Tramcar" being tested for application in a HUD demonstration project to be conducted in the retail core area there. A vehicle of about one-half the length of a conventional bus with about one-half the seating capacity was called for in the basic design requirements. The new vehicle had to permit free intermingling with pedestrian traffic and have a low noise level, an absence or substantial reduction of exhaust fumes, an attractive design, convenient boarding, comfortable seating arrangements and good maneuverability.

In the time since the Washington demonstration program, the number of domestic manufacturers of small buses has increased to at least six. The vehicles are offered in one- or two-door models, in six or more internal seating arrangements, with or without baggage racks, and in a variety of engine/transmission options, depending on the anticipated usage. In addition, open-air "shopping mall" or sight-seeing models are also available.

A typical installation could be expected to cost about $15,000 per vehicle and be operated at $1.40 per vehicle mile. The capacity would be about 18 seated and 12 standing. The route capacity would, of course, depend on speed, stops and headway.

These data suggest that this vehicle, having been thoroughly tested physically and available, might lend itself to real life tests to ascertain desired routes, characteristics and frequency of service. It could provide information to be translated into the desired features or some other, yet to be developed, vehicle. In some instances, the minibus might prove itself to be the proper vehicle for the circumstances.

Other Types

There are in various stages of development a number of "small vehicle" concepts for transit service. Typically, they propose to "package" the passenger either individually or in small groups. In general, most of the systems propose automatic operation, light-weight elevated structure, narrow rights-of-way and electric or other pollutinn-free propulsion. Speeds, capacities, switching methods, terminal designs, environmental aspects, guidance systems, and many other features vary widely from system to system.

Ideally, the users of such systems could have the privacy and security of the private automobile with the high average speeds of the ordinary rapid-transit system, or with considerably higher speeds.

In conventional rapid-transit systems, seating arrangements permit on the order of ore seated person per running foot. The small-car systems generally range about four or five feet of vehicle length per seated person and do not allow standees. Therefore, their capacities are relatively low -- on the order of 10,000-15,000 passengers per hour compared with about 40,000 for conventional rapid transit. As a result, these small car systems are most suited to the medium-volume rapid-transit market.

The state of development of the small-car systems varies from concept, to preliminary engineering, to critical component testing, to prototype installations, to full scale tests. In nearly all cases, capital cost estimates are little more than rough approximations, and financial backing for actual full-scale test installations is difficult to obtain. Operating cost estimates vary from one cent to ten cents per passenger mile.

No real life tests of the kind envisioned in this study have been discovered. World's Faris, amusement parks and some major prototype installations have approximated real life. Every installation seems to have some missing element that precludes real life testing as yet. These data suggest more research and development will be required to arrive at the desired testing level.

Regardless of the type of system proposed, certain hardware functions, as well as certain cost and performance characteristics, must be provided by the transportation system and a range of possibilities exists for each function or set of characteristics. Ranges of possible solutions relating to various functions and characteristics may be classified as follows:

Hardware Functions:

Vehicle Suspension:

- wheels (rubber-tired, steel, or composite design);
- aerodynamic (air-pad, ground-effect and intermediate types);
- electromagnetic;
- liquid (floating, hydrodynamic);
- solid (e.g., Teflon, ice)..

Vehicle Power and Propulsion:

- full on-board power;
- auxiliary on-board power;
- on-board, full-power motors with power pickup;
- unpowered vehicle with traction pickup.

Vehicle Control and Guidance:

- manual, individual;
- manual, operator;
- semiautomatic;
- fully automatic

Guideway:

- roadway; partial freedom to choose course;
- rails, or guides; no freedom to choose course except at junctions.

Guideway Structure:

- all elevated;
- all at grade;
- all partially sunk into the ground;
- all underground
- any combination of these.

System Control and Scheduling:

- on individual vehicles;
- regional dispatching and scheduling;
- central scheduling and dispatching.

Performance Characteristics:

Speed:

- periodic (i.e., stopping);
- fluctuating (i.e., slowing down for transfers);
- steady (for nonstop service, possibly with transfer at speed)

Transfer:

- single mode, implying the need for vehicle change at mode transfer;
- dual mode, or multimode, where a container or capsule may transfer between different modes.

A range of existing, developing, and proposed technologies exists in each one of the above categories. Various combinations of these alternatives have been proposed for urban transportation problems.

The basic requirements of such a small-scale system are these:

1) It must be capable of integration into the "inherited environment";
2) It must be available for operation at least 18 hours a day;
3) It should involve little or no waiting and must be easily accessible;
4) It should operate on low fares, or possibly be free of charge;
5) It should be silent, free from fumes, and safe;
6) It should be open-ended, capable of change, addition, or easy removal;
7) It should have a variable capacity and ability to handle certain goods and deliveries;
8) It should have an average speed of 15 mph*;
9) It should be enjoyable to ride on.

*but with acceleration levels considerably lower than rapid transit

No system of secondary movement having all the above requirements is manufactured today, although several are under study by firms in the U.S. and elsewhere. Many systems, such as multispeed moving sidewalks have been tried with success at expositions over the past 70 years, but no single transport authority has been

prepared to consider their validity in the context of city-center transport. Three factors, however, may lead to introduction of short-distance movement technology: the rising cost of manpower (bus drivers' wages often represent 60 percent of operating costs); public demand for better public transport; and the increase in traffic congestion.

The systems discussed on the next pages are all small in scale and therefore capable of running above street level or even through buildings. They are likely to have high initial capital costs but low operating costs when fully automated systems are available. Maintenance costs are likely to be high, but this will depend on the complexity of the technology.

Teletrans

This system, now under study by the Teletrans Corp., consists of four-seat cars running on an elevated track under computer control. Passengers at each station receive a card punched with their intended destination, which they take to the first car waiting in line. After the card has been inserted into a slot, car doors close and the car accelerates automatically to merge with others passing on the main track. The car runs directly, with no intermediate stops, to the required station, where it is switched into a siding, ready for the next passenger.

Teletrans are now under contract from American Airlines for a study of the system at small scale applied to baggage handling in airports. In Great Britain, a government contract was recently awarded to the Brush Electrical Engineering Co. to develop a system having similar operating characteristics. A fullscale prototype will be tested.

The proposed system calls for theoretical capacities of 20,000 people per hour, which would make it suitable for metropolitan use. The feasibility of Teletrans within existing cities will partly depend on the method of handling cars at stations. A need for large sidings at stations could mean that only extensive and costly land purchase or building space would make the system usable above ground in dense urban areas.

A small car designed only for one degree of freedom is considerably lighter and cheaper. The Telecar is structured around small cars, with solid, non-metallic wheels that run on aluminum rails of a special cross section. Propulsion is provided by a flat linear induction motor with stator windings in the roadbed. With this arrangement, the only propulsive apparatus on the vehicle is a flat conducting plate on the underside of the vehicle.

The unloaded weight of the Telecar is estimated to be only 400 lb. for a 10-ft. vehicle designed to carry two passengers. The weight per running foot is 40 lb., compared with 800 to 100 lb./running foot for unloaded conventional rapid-transit cars, and about 200 lb/running foot for automobiles.

The payoff from this low weight is a cost of about $1200 per vehicle in small lots, and considerably less in mass production. It also pays off in terms of a light structure for the right-of-way. In the Teletrans concept, an enclosed tube would be used as a right-of-way. Spacing the tube windows so that the vehicle passes them at 16 frames per second at 45 mph, the design speed of the system, gives the passenger the illusion of not being enclosed. Costs of the right-of-way have been estimated at $2.1 million per mile for elevated tubes and $3 million per mile for tunnels.

There are two major problems with this one degree of freedom concept: (1) "No passing" means that handling passengers and vehicles at stations poses queing problems and (2) the aesthetics of the tube, which is more of an imponderable. It will be hard to keep the Teletrans tube from looking like the large pipeline that it is; city planners may shudder when they see how it will look.

Carveyor

Designed by Stephens-Adamson and Goodyear, the Carveyor was studied first in 1954 as a system to run underground and replace the Times Square-Grand Central shuttle. An actual full-scale prototype was tested successfully.

In this system, cabins with from four to ten seats run on a track at 15 mph, with boarding platforms at 400-yard intervals. The latter consists of pedestrian conveyors, parallel to the track, and moving at the same speed as the cabins (1-1/2 mph) for people to board or leave in safety. The capacity of the system ranges from 5,000 to 11,000 seated passengers per hour in one direction, depending on cabin size.

In the rapid transit plan for Los Angeles, prepared by Daniel, Mann, Johnson & Mendenhall, the carveyor was one of the systems considered for downtown distribution. Atlanta proposes to use it in its rapid transit plan, also as a distribution system. Victor Gruen, in his plan for New York's Welfare Island, proposed using the Carveyor to run the two-mile length of the island as the principal system of internal transportation.

Only one known comparable system, the Carlator, is operating today, in a recreation park in Japan. After runnig three years, it has achieved an annual capacity of over a million people, at a maximum rate of 3,000 passengers an hour.

Cost estimates of the carveyor vary from $4.8 million to $7.4 million per mile for a two-way installation, and funds are now being sought for a half mile demonstration line.

Dashaveyor

This system is relatively unknown as yet in the transport field, but is considered by mechanical handling specialists to be one of the most technically advanced and robust systems developed to date. Designed by the Dashaveyor Co., it consists of small six-seater cabins, called "modules", which run within an enclosed tubular guideway. The modules can operate singly or in "flights" of up to 20 cars. The modules re electrically propelled and remote-controlled to slow down, empty, fill up, and accelerate to speeds of up to 80 mph. The system is capable of running horizontally, vertically, up and down inclines-even under water.

A five-mile installation has operated for over a year at a copper mine in Michigan, and the system is claimed to be ready for application to the field of public transport. The company claims a number of public agencies have expressed interest in the new system.

Capabilities

- High speed level runs
- vertical ascent and descent
- horizontal and vertical switches
- Central Control possibility
- Extendable guideway
- Elevated underground and underway
- Can move people as well as freight
- The guideway, suspension can be used with linear motors
- No clutch, gear shift or fluid drive
- Wheels press together to get up a 20% grade - than an underslung sprocket engages
- $100/foot for guideway cost-built
- Shuntoff at speed for passenger pick up and discharge - save power costs of starting up whole train
- Switch is
- Modules are 6 passenger, 12 passenger, and 24
- Vehicles cost $1,000/person for 12 pass. - $1,200/person for 6 pass.

Transveyor

Conceived by the Battelle Institute of Geneva, in cooperation with Sud-Aviation the Transveyor is now under development for use in the new Paris Nord Airport and should be operational within two years. It consists of a series of platforms about 6 ft. square onto which the passenger steps, as onto an escalator. Doors close first in front, then behind. The platform then accelerates to 15 mph, until slowing down at the end of the trip, when the reverse procedure occurs.

At present the design is intended for use between points with no intermediate stops. It is suitable for use in a situation such as a shopping center parking lot, where a distance of half a mile or more is too long for a normal pedestrian conveyor. Capacities are estimated at 7,000 people an hour, and the system is small enough to run elevated. Boarding platforms require about 12 ft. of depth, sufficient for the system to turn around.

Peoplemover

Designed by WED Enterprises and Goodyear, the Peoplemover is an automatic, continuously moving system. It consists of four-seater cabins running at 7 mph on an elevated guideway 6 ft. wide; and it has a capacity of 4,800 people an hour. Stations consist of revolving circular platforms, around which the cabins circle at the same speed, doors opening automatically.

The Peoplemover is being developed as a transport system for use in Disney's new Florida city of EPTOC where the tracks will radiate from the central shopping and business zone out into the residential areas, reducing the need for parking in the center. The system has been operating successfully at Disneyland since September. The circular boarding platforms likely would be too large for use in dense city centers; parallel conveyor belts would consume less space.

Minirail

Designed by Habegger of Switzerland, the Minirail consists of a series of small 12 seat cabins joined into trains. It runs on a twin steel-channel track under automatic driverless control at speeds of up to 15 mph.

The system operating at Montreal's Expo 67, carrying 5,400 people per hour over an elevated track through the grounds. Its function was primarily that of a sightseeing system, generally with a one-way track and relatively few stations. Unfortunately, due to high demand, the system became overloaded.

(At Lausanne, incidently, the Minirail ran over, under, and straight through several of the buildings, demonstrating its adaptability to difficult urban situations.)

The Montreal system and the two previous installations at Munich and Lausanne used openair cabins designed specifically for exhibition use. More recent designs use cabins that are fully enclosed and have automatic doors. The most recent serious proposal by an authority for its use is at Haringay, North London, where it is intended as a connector system between car parks, the main shopping center, and the underground station.

Installation and operating costs are low: the Lausanne system, with a 20¢ fare, paid for all development and operating costs after running six months.

Guide-O-Matic Train

Designed by Barrett Electronic Corp., this system uses a small scale train that follows a guidance cable laid in the floor. It is now being installed as an underground circulation system at Houston Airport.

Each train consists of three eight-seater coaches and a forward "power unit" containing batteries that supply power to dual rear-wheel motors. Built of aluminum and fiberglass, each train is 7 ft. 6 in. high, 5 ft. wide, and 45 ft. long.

A four-train system, such as that at Houston Airport, can handle 200 passengers in a ten minute peak period, with a maximum hourly capacity of about 1,200 people. Operation is fully automatic, requiring no driver. An electronic monitor on each train sends malfunction alerts to a central control station, where an attendant mans an electronic console.

Transit Expressway

Developed by Westinghouse Electric Corp., the Transit Expressway, or "Skybus" is larger in scale than the other systems discussed here. It is intended primarily as a commuter system for medium-density areas. In 1965, a 9,340-ft. test loop was installed in Pittsburgh's South Park where some 135,000 passengers rode the system in two years. The Port Authority of Allegheny County now plans to build an operating Skybus shuttle line between the Golden Triangle and a suburban area.

The electrically propelled Skybus cars run on four pairs of pneumatic tires along an elevated steel roadway topped with concrete "tracks" 22 in.wide. The cars are stabilized and locked in place by sets of chassis-mounted horizontal guide wheels which engage a steel "guide beam" between the tracks.

The Skybuses would operate 24 hours a day, using single vehicles during off-peak hours, and linking them into trains of up to ten cars at peak times. The maximum speed is 50 mph, and load-carrying capacity is 21,000 passengers per hour.

The trains are fully automatic, requiring no motorman, conductor, or attendant on board. They are so quiet, claims Westinghouse, that they could operate inside a building without disturbing its occupants.

For large cities, Westinghouse forsees the use of the Skybus as an outlying feeder for the central rail rapid-transit system. In smaller urban areas, where it would be the central system, its outer parts would be served by feeder buses.

Summary

This investigation of hardware available for distribution of people in a downtown area has uncovered a great variety of ideas and a severe limitation on availability.

One characteristic which most of the hardware systems have in common is the necessity of establishing specific stations for loading and unloading. This is particularly apparent for any system which utilizes a vehicle, and is even more evident for automatic operation. The distance between stations depends on loading times, acceleration and deceleration, maximum speeds and the method of bringing the vehicles into the station.

With the exception of the minubus, all of the systems require some type of special guidway which must be spatially separated from cross movements and thus must be a level above or below normal street grades. Investigation of the area below street grade at the Airport indicates a situation of high ground water, a complex of utilities and lower level activities which almost completely preclude the location of a distribution system at the first level below grade. Investigation of the levies above grade presents a much more feasible and optimistic picture. New developments could accommodate space for an upper level distribution system. Most existing structures could be converted to some type of hanging, cantilevered or supported space for this purpose. In most cases uses on the upper floors of existing buildings could be revised without major disruption of services or functions.

Many of the guideway systems must be eliminated from consideration for immediate installation at the Airport for one or more of the following reasons:

1. Low capacity
2. Short distances not compatible with speed characteristics
3. Vehicle availability not immediate
4. Excessive costs of development and installation
5. Adverse aesthetics

None of the existing or proposed hardware systems accomplish all the desired results of this study. Most of the sophisticated systems are barely more than concepts, with very little work having been done on either vehicular or guidance system design.

When all factors are taken into consideration, it appears that only two kinds of hardware are immediately available -- moving belts and minubuses. The advantages and disadvantages of each of these systems must be considered.

The moving belt has high capacity, is comparatively inexpensive and is relatively easy to install. It occupies the least amount of space of all the systems, both vertically and laterally. Its major disadvantage is that it is slow. Nevertheless, it comes nearest to meeting a number of objectives and a thorough test of its ability is in order.

The minibus is a much discussed type of hardware which appears to have much versatility. It has been used in limited numbers in many places, but it apparently has not been used as part of a larger distribution system. Its major advantage is its maneuverability and flexibility or routing. Its major disadvantage is the cost and problems of operation and maintenance.

It must be emphasized that neither the moving belt nor the minibus is necessarily considered to be the final answer to airport distribution. It is conceivable that a different concept and/or a hardware system can be developed which is more efficient than any now under consideration.

In 1966, the Massachusetts Institute of Technology, Interdepartmental Systems Design Course contributed to the awareness of need for further development of public transportation at the Airport by a student presentation "Project METRAN". It was described as an evolutionary integrated urban transportation system. It presented automated transit possibilities including that of a PERC (Personal Capsule) vehicle that was proposed for testing at Logan Airport. It was suggested that the Federal government might provide a $15 million grant. The PERC vehicle would carry two

passengers. It would measure approximately 4 feet wide by 4 feet long and 6 1/2 feet high. It was estimated that it could be operated at a speed of 20 miles an hour with a system capacity of 16,000 persons an hour.

The MIT students proposed a loop from the Airport MBTA station to the terminal buildings with six or seven stations along the loop.

APPENDIX D

PERIODICAL AND NEWSPAPER REPORTS ON AIRPORT ACCESS IMPROVEMENTS

Cleveland Hopkins International Airport,
Minneapolis - St. Paul, Houston

veland Patrons Are Pleased With Rapid Trans

to The New York Times

LAND, Nov. 23 — drivers and the men e buses through traf- eginning to complain, erally the Cleveland System's rapid transit, to Cleveland Hopkins inal Airport already public acceptance.

xtension opened early after a shaky start. -mile extension had eduled to open six ier, but was delayed o electrical dif- of electrical diffi- The four-car inaugural de the 11-mile trip to Union Terminal on day, but the public t ride until this Thurs- n service was marred lision that injured 32. The system is the ort-to-downtown city the United States.

ed and silver rapid ars are scheduled to trip form the down- to the airport in 20 for a fare of 35 cents. aning time, including , has been closer to es, but riders do not ind.

us Waits to Fill

uld take me nearly es if the airport bus dy to leave when I ut of the terminal," business man. "How- buses usually wait are full. This way I an get a train within cs. I think it's great."

's of the system said far showed that an of nearly 25 persons rains to or from the They expect this to as more people, es- rom out of town, be- are of the service.

ffic count, taken dur- 0-hour period on the of service, showed people arrived at the y the new extension eft by the same route.

Come One Night

n't like it," said one driver. "Anyone who rapid to or from the night have been a $5 me. I used to average one airport trip a day, n two or three if I ky. Now I'm afraid sit longer at the air- port waiting for a trip back."

A majority of those using the rapid transit system on its first two days were businessmen who were going to be gone only one night.

"I can carry my small bag," one Cleveland lawyer said. "I can leave my office downtown and be at the airport ticket counter in just 30 minutes—and not have to worry about traffic jams, weather conditions or looking for a parking space. I'd probably still use a cab or the airport bus if I had more than one bag."

Roy Kiely, airport supervisor for the Yellow Cab Company, which operates both cab and airport bus service on a monopoly basis, said he believed the company and its drivers would be hurt in the long run by competition from the trains, but it was too early to notice any great effect.

Some travelers from other cities complained that there were not enough notices in the main airport terminal, or on the way through the gates, telling of the rapid transit service. Several signs are in the lower baggage-claiming area, but these were overlooked by many.

Must Walk Outside

In addition, to get to the trains, patrons must walk outside the terminal, past the bus and cab loading zones, cross a small covered roadway and walk about 75 feet to the entrance.

Travelers rom outside Greater Cleveland who used the new system generally were pleased with the service and the speed to the downtown section.

"I only hope New York gets something like this to Kennedy [Airport] as soon as possible," said one Manhattan sales executive. "They're talking about it, and believe me, that service is really needed. It takes me longer to get from my apartment on the upper West Side to Kennedy or La Guardia, even in nonrush hours, than it does to fly from New York to Cleveland. There's got to be a better way to get to the airport, and I think a subway or a rapid like Cleveland's is that only way."

Study Checking Service

The only major complaint that the visitors had was the lack of baggage service, both at the airport and at the terminal—the extension's only downtown stop. Luggage racks are provided in the cars, but patrons have to put the luggage on and off themselves.

Major airlines using the airport have balked in the pr at providing baggage servi except at their own airpo ticket counters.

They are taking a wait-and see attitude on the trains and their use by airline passenger before deciding whether it would be economically feasible to provide downtown checking service.

Airline and airport em ployes have begun to use the system to get to work instead of driving. Generally they are enthusiastic about it.

Airport officials said they had not noticed any decline in the demand for parking space but said it was still too early to tell.

"Wait until after Christmas and we can tell better," said one city official. "That's when the rapid will either prove successful or not."

Airport Electronic Train

Houston Intercontinental Airport, designed for supersonic aircraft, will use automatic trains in its passenger transportation system within the massive airport. Four Barrett "Guide-O-Matic" trains, which can take passengers more than a third of a mile in less than four minutes, have a peak capacity of more than 23,000 passengers a day. The trains, each comprising the electronic power and guidance unit and three passengers cars, will run at two-minute intervals, 24 hours a day. The electronic train, driverless and trackless, finds its way through an underground route by sensors and guidance devices which respond to instructions from a wire imbedded in the concrete floor and from safety signals throughout the route. The Barrett "Guide-O-Matic" trains are being installed now, with the airport to open later this year.

For further information, contact Barrett Electronics Corporation, 630 Dundee Road, Northbrook, Illinois 60062.

New 'Twin Trans' Service to Airport From Downtown Twin Cities Begun

MINNEAPOLIS, MINN. — The Twin Cities Area Metropolitan Transit Commission, working in cooperation with the Twin Cities Bus Lines, has established a new bus service, nicknamed the "Twin Trans" which will provide comprehensive bus service from both downtown Minneapolis and St. Paul to the Twin Cities International Airport and firms in the airport area.

"Twin Trans" service began August 5 with a special kick-off event. Service now is available from downtown Minneapolis and downtown St. Paul to the airport area from 6 a.m. to midnight seven days a week.

No fares will be collected on "Twin Trans" the first week. After the first week, patrons will pay 40¢ for the service. Transfers from regular Twin Cities lines will be accepted and transfer riders who have already paid the standard 25¢ fare will pay an additional 15¢ when leaving the Twin Trans bus at their destination.

In Minneapolis the bus will go out Second Avenue making stops at connecting bus line corners downtown. The bus goes to and returns from the airport area on 35W, stopping only at Lake Street. Downtown it returns on Marquette. In St. Paul, the bus will go out on 6th St. and 7th St., making stops at connecting bus line corners. It returns downtown on 5th St.

Bus stops in the airport area include: Building 22 in the Fort Snelling area; airport terminal and post office; Northwest Airlines shops and offices; the new North Central Airlines base; Control Data; 24th Ave. & Hwy. 494. Future stops will include the Metro Office Park area, and General Service Administration Building and the proposed "Park and Ride" parking lot near Cedar Avenue and Highway 494 on airport property.

The lack of public transportation to the airport area has been a handicap for both employers and employes. Prior to the establishment of "Twin Trans" persons who worked in this area had to depend almost entirely on private transportation. There are presently 15,000 employes in the airport area and a minimum of 25,000 are expected by 1985. Persons who did not have access to private transportation were held back from taking advantage of employment opportunities in this area.

"Twin Trans" is the first step in the Metropolitan Transit Commission's plan to improve existing Twin City area public transportation and to fill in gaps that, because of economic considerations, could not be resolved by private bus lines alone.

Members of the Commission include: Lester Bolstad, Jr., Theodore R. Brouillette, Dean Fenner, Edward R. Hjermstad, Bernart T. Holland, Bruce G. Nawrocki, James P. Martineau, Loring M. Staples, Jr., and Warren G. Hyde. Bolstad was appointed by the Governor, Brouillette by the City of Minneapolis, Fenner by Ramsey County and the City of St. Paul, Hjermstad by Carver, Dakota and Scott Counties, Holland by the City of St. Paul, Nawrocki by Anoka and Washington Counties, Martineau by the Mayor of Minneapolis and Staples and Hyde by Suburban Hennepin County.

Here Briefly...

PITTSBURGH, PA.—Effective August 1, 1968, prices were to be increased 8.2% on electrical propulsion drives and control and auxiliary equipment for rapid transit and rail commuter cars, Westinghouse Electric Corp. announced. The price increase is a direct result of substantial increase in labor and material cost over the past several years.

Airport Extension Will Solve Jet Age "Parado

The universal complaint of air travelers, "It took me longer to get to the airport than to fly . . .", will be history in Cleveland where the Cleveland Transit System is completing the building of the 4-mile rapid transit extension from its West Park Station to Cleveland Hopkins International Airport.

When the extension is opened in November, 1968, running time to the airport from downtown Cleveland, the hub of the rapid transit line, will be 20 minutes. In comparison, the trip by car takes about an hour in rush hours.

No longer will air travelers complain that the drive downtown from the Airport took longer than a flight from Newark to Cleveland.

The extension of the rapid transit system was accomplished primarily with federal funds under the Mass Transportation Act of 1964.

Cleveland was the first city to apply for a grant to extend its rapid transit. The application was submitted April 14, 1965, and approved by HHFA on June 9, 1965.

The original grant from the Federal Housing & Home Finance Agency was for $6,995,000. And when the comprehensive Cleveland-Seven County Transportation Land Use Study was completed in July 1968, the government allocated

Cleveland's transit system has run the gamut of all problems faced by urban transit during the Twentieth Century. Its history has been complex, often stormy, but it has emerged with a system that works with extraordinary success.

"C.T.S. belongs to the people of Cleveland. But as taxpayers it has never cost them a cent. As patrons of their system, they have paid off the bonds issued for its purchase. For almost twenty years the system has operated in the black at no cost to the taxpayer except in his capacity as rider of the cars and buses. The system has been excellently managed. C.T.S. faces the future on a basis of efficient operation and foresighted planning."

• • •

"The Cleveland Transit System has been willing to think boldly and to do things. Instead of following the predominantly negative trends of the transit industry, Cleveland has acted positively. The transit board and management have believed that the rider wants speedy, clean, and safe service and that he will pay for it—hence, the system has turned to rapid rail service fed by local, express, and super express buses. Patrons are supplied with route time tables, and every effort is made to keep on schedule. Aluminum shelters which protect against rain and snow have been erected at key intersections — and, to date, the walls have been kept free from advertisements. Land for parking has been purchased near many of the stations along the rapid. Efforts have been made to make the transfer from surface to rapid lines easier, including the installation of up-escalators at centers of traffic concentration. Buses have been Dieselized and maintenance costs have been reduced as overhauls are now completed after some

veland dignitaries enjoy
inaugural run of the "Air-
rters."

additional $2,220,000 for the
oject. Additionally, bond issues
proved by the voters of Cleve-
nd and Cuyahoga County were
ed to finance parking lots and
idges.

The City of Cleveland has spent
00,000 on parking lots at two new
id transit stations and $450,000
an access roadway into one of
parking lots. The stations have
jor facilities for the System's
y successful "park-n-ride" serv-
and loading platforms to accom-
date feeder bus lines as well as
thousands of "kiss-n-ride" pas-
gers. There will be parking at
two stations for a total of 2,500
s.

Cuyahoga County has spent $5,-
,000 on the project by providing
five bridges along the rapid transit extension.

The original cost of the project was $14 million. The cost (November, 1967) stood at $18,400,000.

Ground-Breaking

Ground-breaking for the extension was in June of 1966, and the new airport line will not only provide better access to the air lines, but also will greatly improve public transportation in the rapidly-growing surrounding area. This area contains important industrial plants, such as the Ford Motor Company, the Lewis Flight Propulsion Laboratory of NASA and the Chrysler Tank Plant, as well as the residential centers of Berea and North Olmsted.

On June 18, 1967, Mayor Carl B. Stokes drove the first spike as the Cleveland Transit System began laying track for the airport extension. More than 95,000 spikes were used for the 1,680 tons of rail purchased from Bethlehem Steel at a cost of $250,000.

Passengers will travel in comfortable, modern 70-foot air-conditioned cars. The 20 new cars which were built by Pullman-Standard at a cost of about $175,000 each, were delivered to Cleveland in October, 1967, They are in regular line operation until the extension is completed.

The "Airporters"

The "Airporters" — the first rapid transit cars specifically designed for

50,000 miles. Special service
ch as 'loop' and 'charter' buses
ve been developed. Even the
guments of County Engineer
rter have been approached pos-
vely — by conceding that free-
ys should be built, but that be-
use of their high cost and limit-
l capacity, they can only be an
junct to and not a substitute for
gh speed, mass transportation."

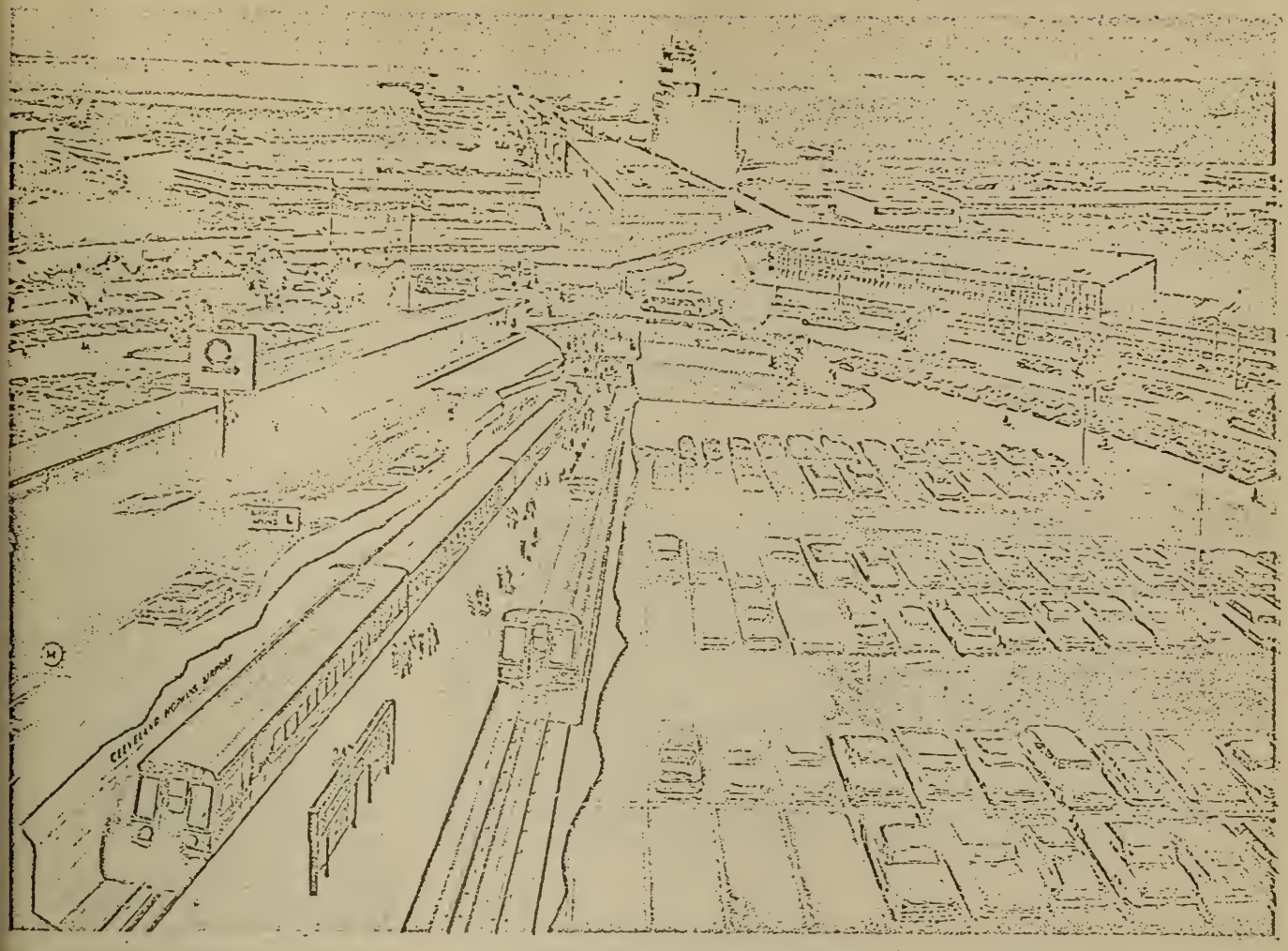
• • •

"Public transit in Cleveland has
en a 'profit-making' venture. Ex-
pt for deficits in 1947 and 1948,
ch of the years from 1942
rough 1959 has seen a surplus.
e dividends which could have been paid to stockholders under private operation have gone into new equipment and improvements and the surpluses have been used to reduce the interest costs for capital improvements.

Thus, Cleveland, at the three-fifths mark of the Twentieth Century, had evolved one of the best publicly-owned-and-operated transit systems in the nation. From the complications and confusions which prevailed at the beginning of the century, when more than thirty transit franchise-holders used the streets, two dominant companies emerged. From the long dispute between private vs. public ownership, the Taylor compromise created a single private company, whose every more, however, was scrutinized by a group of young men devoted to the public service. The miseries of the Cleveland Railway Company, troublesome in the 1910's, somewhat relieved in the 1920's, became acute in the 1930's and resulted in public ownership in 1942.

"While many cities, in the ensuing decades, watched their systems atrophy, that of Cleveland had remarkable growth. . ."

Dallas M. Young (1960)
"Twentieth-Century Experience in Urban Transit" (A Study of the Cleveland System)



Artist's conception of the Cleevland Hopkins International Airport after the CTS rapid transit extension is completed late in 1968.

passenger service between a metropolitan airport and the downtown business district, are built of stainless steel and are capable of traveling up to 60 mph. Four 100-hp motors power each car. Each car has tinted windows to reduce glare and keep out the infra-red rays of the sun.

An entirely new concept in heating and ventilating developed by the Vapor Corporation of Chicago was installed in the cars. Air conditioning is tied in with the heating system so that either cold or hot air is entered into the cars at the window sill level. There are no roof fans.

The cars are fluorescent-lighted with the lighting recessed to frame the car card advertising racks. This will permit opaque advertising cards to be used.

The seats are wider than in the present CTS rapid transit cars and are spaced further apart for added passenger comfort.

Each car is equipped with two luggage racks to accommodate the airport traveler.

With the extension to the airport, Cleveland will become the first city in the United States to have a rapid transit line serving the downtown area and the airport.

Recognizing the complex problem of adequate transportation service in and out of town, the Cleveland Transit System has developed plans for metropolitan rapid transit facilities that will combine special link services, flexibility, comfort, safety and speed in co-ordination with road services.

Fast private right-of-way transportation plus adequate parking facilities have proven to be a combination capable of drawing commuters to public transportation and thereby relieving the traffic load on city streets.

The present CTS Rapid Transit System is the most recent completely new rapid transit installation in the United States. It cost over $39,000,000 which is being paid for solely from the revenues of the Cleveland Transit System. It is 15 miles in length and extends from West Park Station on the west side through downtown Cleveland to Windermere Station in East Cleveland.

Cleveland opened its 13-mile rapid transit line in 1955 and extended it two miles in 1958 to the present westerly terminal at West Park.

Read for Service....

Many innovations included in the CTS 70-foot, 80-passenger air-conditioned stainless steel "Airporters."

The first rapid transit cars specifically designed for passenger service between a metropolitan airport and the downtown business district will start operation on November 15, 1968, the official opening date of the Cleveland rapid transit extension.

The "Airporters," 80-passenger, air-conditioned cars, were built by Pullman-Standard's Chicago plant, Pullman Car Works, for the Cleveland Transit System (CTS). Cleveland is the first United States city to request and qualify for Federal funds for an airport to downtown rapid rail system, and it will join two other cities in the world – Tokyo and Brussels – as the only cities having such facilities. An added advantage to Cleveland's airport extension project, which was financed by a 2/3 Department of Housing and Urban Development (HUD) grant matched by a 1/3 City-County funds, is that it connects with other CTS city-county rail commuter stations.

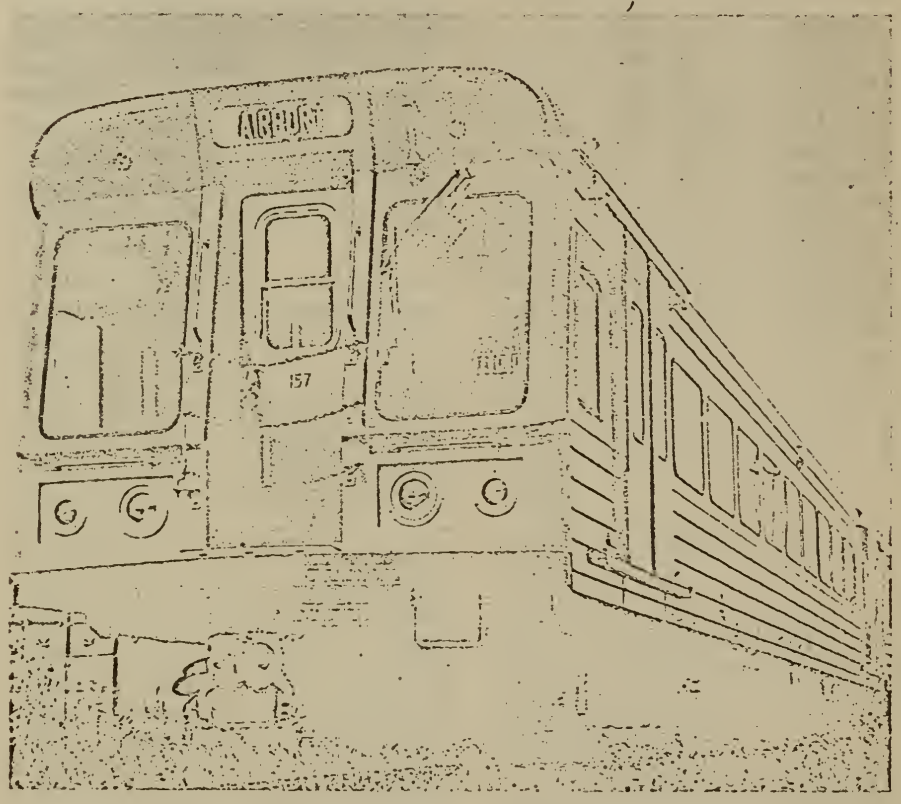
The 70-foot cars are capable of moving 80 seated passengers each at speeds up to 60 mph from downtown Cleveland to the Cleveland-Hopkins Airport in 20 minutes.

According to CTS, stainless steel was selected for major components of the cars because of its corrosion resistance, ease of maintenance, and a high strength-to-weight ratio that permits lighter-weight cars which cost less to operate.

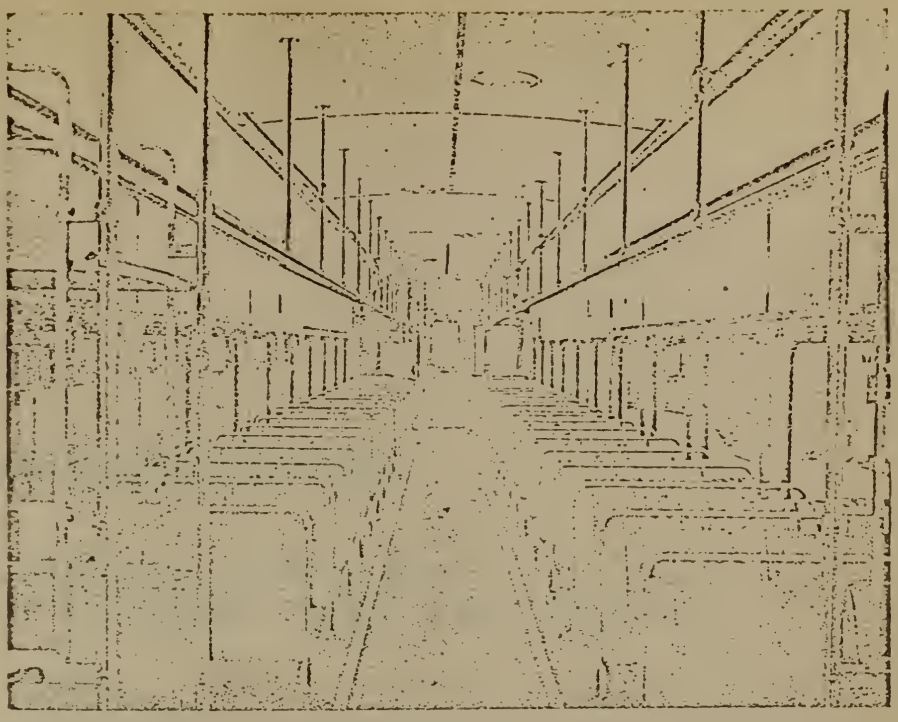
Republic Steel Corporation supplied about 90,000 lbs. of Type 301 stainless steel for the two most visible components of the cars – the roofs and sides. Pullman-Standard reported that more than a thousand sheets of Republic's stainless steel, ranging in sizes from 39″ wide by 12′ long to 58″ wide by 9′ 3″ long, were used for the cars.

The sheets which ranged in thickness from 3/16 to 3/64 inches, were supplied with Republic's Ezy-Blend finish. It compares to a standard 2B finish that is given a light abrasive polish which makes weld blending and matching easier during fabrication. Prior to being shipped, the sheets were covered with a strippable adhesive paper coating to protect them during fabrication.

In fabricating the roof sections, three sheets are lap seamed and welded to form a 12-foot-square blanket that is attached to the roof by Huck lock bolts. Individual roof sheets measured 49″ x .040″ x 12″.



Gleaming stainless steel cars were built by Pullman-Standard's Chicago plant, Pullman Car Works.



"Airporters" have seats wider and farther apart than in present CTS 52-seat cars.

The roof sheets overlap the side sheets of the cars and lock bolts, attached to the top plate, join the two sheets.

The largest sheets required for the sides of the cars measured 39" x 0.060" x 10', and they were used for the bottom third of the car sides. To add rigidity and strength, and to prevent oil-canning, panel sections were given a ¾-inch-deep fluting, or ribbing, set on 6-inch centers. The panels were lock seam weld joined, and then were spot welded to the vertical uprights from the underside. Huck bolts were used to join the top and bottom sections to the roof, and to the bottom rail.

The United States Steel Corporation supplied the stainless steels and COR-TEN Type A high-strength (50,000 psi), low-alloy steel for the underframe and body structural strength.

Specially-built luggage racks located at the front and rear of the "Airporters."

To build a strong but light transit vehicle, Pullman-Standard fabricated an underframe assembly using both COR-TEN and stainless steel components. Side sills of the underframe are Type 201 stainless steel while the center end sill is high-strength steel—pressed channel fabricated by the builder from COR-TEN plate. Cross and members also are COR-TEN steel.

End frames of each car are fabricated of COR-TEN plate and are designed to withstand a 200,000-pound impact load.

Auxiliary components for the cars including air compressors, electronic controls and air-conditioning equipment, are supported from the underframe.

Superstructure of the car contains USS stainless steel sheets for the sub-flooring sideposts, floor supports, side sheet stiffeners, corner posts and window frames are USS type 201 stainless steel. Design of the superstructure called for the seating of 80 persons with luggage racks at floor level in the front and back of the car. Seats can be removed if more luggage space is desired.

The luggage handling design is a departure from the traditional overhead racks of rail vehicles. Located just inside the doors of the cars, the racks will facilitate easy handling of heavy and cumbersome baggage.

Total cost of the airport-to-downtown project, including approximately $3.5 million for the 20 cars, is a little over $18 million. Also included in the project were: a new underground CTS terminal at the airport which allows passengers to alight just steps away from the check-in counters; purchase of rights-of-way and relocation of sections of the New York Central Railroad (Penn Central) industrial siding tracks required for the four-mile extension; the construction of two new commuter parking lots and stations, and the completion of five bridges.

The trip from the airport to downtown Cleveland will cost 35 cents.

The seats are wider, than in the present 52-passenger CTS rapid transit cars which are 48' long, and are spaced further apart for added passenger comfort.

As the first modern city-center to airport transit system moved into its final stages of construction, airlines servicing the Cleveland airport were studying methods to handle baggage and ticketing in the Cleveland Union Terminal. ▷

APPENDIX E

HIGHWAY ACCESS TO AIRPORTS

A Memorandum from F. C. Turner, Director of Public Roads to Regional Federal Highway Administrators.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
WASHINGTON, D.C. 20591

June 18, 1968

CIRCULAR MEMORANDUM TO: Regional Federal Highway Administrators and Division Engineers

FROM : F. C. Turner
33-37 Director of Public Roads

SUBJECT: Highway Access to Airports

Enclosed is a tabulation of information on travel between major CBD's and airports for all major hub airports currently listed by the Federal Aviation Administration. This information was extracted from reports submitted in response to our November 30, 1967, circular memorandum, this subject. Travel between CBD's and medium hub airports is being studied.

The traveltimes shown were normally determined from speed and delay runs during the peak and offpeak travel periods. As such, they are representative of only the actual traveltime between the CBD and the airport. They do not allow for either processing time at the terminal, or leeway allowed by the traveler to assure that he will not miss his plane.

It must be noted also that these traveltimes only consider the trip from the CBD to the airport in question. Trips to the airport have origins throughout the metropolitan area, and for this reason this summary may not be fully representative of the entire airport access problem.

Normally, more airport travel is directed to the CBD than to any other single point in the city which makes this particular trip most susceptible to handling by public transportation. The very nature of air travel places considerable emphasis on public transportation as the traveler usually will not have a private vehicle available to him on both ends of his air trip.

-more-

This information should be of value in comparing the accessibility of individual airports and in determining the degree of betterment that might be expected from individual improvements in a given corridor.

Please advise us of all actions taken by your office or the State in all system adjustments to the major routes serving airports and of all planned improvements on the major or alternative access routes.

Enclosure

HIGHWAY ACCESS TO AIRPORTS

LARGE HUBS

Hub	Airport	CBD	Distance (mi.) Maj. Rt.	Distance (mi.) Alt. Rt.	Descrip. of Maj. Rt. Miles	Av. Travel Time (min.) Maj. Rt. Peak	Av. Travel Time (min.) Maj. Rt. Off-Pk.	Av. Travel Time (min.) Alt. Rt. Peak	Av. Travel Time (min.) Alt. Rt. Off-Pk.	Travel Speed (mph) Maj. Rt. Peak	Travel Speed (mph) Maj. Rt. Off-Pk.	Travel Speed (mph) Alt. Rt. Peak	Travel Speed (mph) Alt. Rt. Off-Pk.	Public Transp.	Comments	Field Evaluation of Current Cond.	Actions Initiated
Atlanta, Ga.	Atlanta	Atlanta	8.9	9.4	I: 8.3 FAS: 0.6	24.5	12.7	32.0	24.0	21.8	42.0	17.6	23.5	Taxi Limo. Bus	Major Rt. is used extensively. Alt. Rt. is used only when accidents or other congestion on major Rt. Future access rd. needs under study. Rail mass transit system under study.	Facilities provide good service to airport.	None
Boston, Mass.	Logan Int'l.	Boston	4.0	4.5	I: 0.5 FAP: 2.0 Other: 1.5	25.0	16.0	27.0	20.0	9.6	15.0	10.0	13.5	Taxi Limo. Bus	Principal delay points are the portals to tunnels - uncontrolled plazas with cross-traffic. MTA studying addition of another tunnel. Modify expressway ramps.	Excellent hwy. conn. Excellent rapid trans. service	MDPW contracted consultant to study tunnel entr. problem and make recom.
Chicago, Ill.	O'Hare Chicago Int'l.	Chicago	17.5	-	I: 15.0 FAP: 2.5	45.0	27.0	-	-	23.4	39.0	-	--	Taxi Limo. Bus	Most of delays are caused by heavy pedestr. & veh. movements downtown and from congested ramp connections and weaving. Ramp metering studies under way.		
Chicago, Ill.	Midway	Chicago	12.0	-	I: 7.5 FAP: 4.5	33.0	23.0	-	-	21.8	31.4	-	-	Taxi Limo. Bus	Delays due to pedestrian and veh. movements in downtown. Heavy ramp movements. Two alternate routes proposed. When completed most of delays will be eliminated.		
Cincinnati Ohio	Greater Cincinnati	Cincinnati	13.0	-	I: 9.0 FAP: 0.5 FAS: 3.5	22.8	16.8	-	-	34.2	46.5	-	-	Taxi Limo.	The only delay during peak hour is at the 4th St. & Sycamore Ave. intersection, about 1.5 min. When I-275 is completed in Ky., the trip will take only about 12 min.	Excellent - Most of the trip on expressways.	None
Cincinnati Ohio	Greater Cincinnati	Covington, Ky.	11.6	-	I: 7.3 FAS: 3.5 Other: 1.0	16.1	14.6	-	-	43.0	47.5	-	-	Taxi Limo.	A small delay during peak in the CBD. With completion of I-275, travel time will improve.	Excellent	None
Cleveland, Ohio	Cleve. Hopkins Int'l.	Cleveland	14.0	10.4	I: 9.5 FAP: 3.5 FAS: 1.0 Other: 0	25.0	20.0	33.5	27.3	33.6	42.0	18.7	22.8	Taxi Limo. Rail- Bus	Most delays due to signals in CBD. When I-90 connects I-71 to Airport Frwy. (1970) travel times will be 5 min. shorter. In late 1968 rail transit from CBD to airport will be available.		

(CM 6-18-68)

HIGHWAY ACCESS TO AIRPORTS

LARGE HUBS

Hub	Airport	CBD	Distance (mi.) Maj. Rt.	Distance (mi.) Alt. Rt.	Descrip. of Maj. Rt. Miles	Av. Travel Time (min.) Maj. Rt. Peak	Av. Travel Time (min.) Maj. Rt. Off-Pk.	Av. Travel Time (min.) Alt. Rt. Peak	Av. Travel Time (min.) Alt. Rt. Off-Pk.	Travel Speed (mph) Maj. Rt. Peak	Travel Speed (mph) Maj. Rt. Off-Pk.	Travel Speed (mph) Alt. Rt. Peak	Travel Speed (mph) Alt. Rt. Off-Pk.	Public Transp.	Comments	Field Evaluation of Current Cond.	Actions Initiated
Cleveland Ohio	Cleve. Hopkins Int'l.	Akron	45.4	-	I: 36.5 FAP: 2.5 FAS: 2.4 Other: 4.0	56	54	-	-	47.5	49.0	-	-	Limo.	Delays are temporary. Upon completion of I-77 at Fairlawn, delays will be eliminated.		
Dallas/ Ft. Worth, Tex.	Dallas Love Field	Dallas	7.5	5.3	I: 4.4 Other: 3.1	16.5	14.0	15.0	12.5	27.3	32.2	21.2	25.4	Taxi Limo. Bus Heli-copter	No undue delays experienced.		
Dallas/ Ft. Worth, Tex.	Dallas Love Field	Ft. Worth	38.6	34.9	I: 4.8 FAP: 1.2 Other 32.6	44.1	44.1	42.9	42.9	52.5	52.5	49.0	49.0	Limo.	No significant delays		
Dallas/ Ft. Worth, Tex.	Greater Southwest Int'l.	Ft. Worth	23.2	18.6	FAP: 1.2 FAS: 5.1 Other 16.8	23.4	23.4	26.3	26.3	60.0	60.0	42.0	42.0	Limo.	No significant delays.		
Denver, Colo.	Stapleton Int'l.	Denver	6.1	9.4	Other 6.1	17.2	15.5	19.9	21.1	21.3	23.6	28.3	26.8	Taxi Limo. Bus	The peak and off-peak travel speeds approach posted speed limits. Any delays are caused by signals. Hwy. delivers all airport traffic that the airport can handle	Very Good	The State will be encouraged to place the Rt. on the F.A. System
Detroit/ Ann Arbor, Mich.	Detroit Metro-politan	Detroit	18.3	20.1	I: 13.5 FAP: 4.3 Other: 0.5	47.0	32.0	57.0	35.0	23.5	34.5	21.2	34.7	Taxi Limo. Bus (Heli-copter planned)	Delays are due to congested freeways. Improvement projects are scheduled. Proposed freeway to connect south of airport.		
Detroit/ Ann Arbor, Mich.	Willow Run	Detroit	30.2	32.0	I: 24.9 FAP: 4.3 Other: 1.0	62.0	47.0	72.0	50.0	29.3	38.7	26.7	38.6	Taxi	All delays occur between Detroit and Metropolitan Airport. No passenger demand for Willow Run. Mostly air freight and general aviation.		
Detroit/ Ann Arbor, Mich.	Detroit Metro-politan	Ann Arbor	25.4	-	I: 18.4 FAP: 6.1 Other: 0.9	40.0	40.0	-	-	38.0	38.0	-	-	Taxi Bus	No noticeable delays.		

HIGHWAY ACCESS TO AIRPORTS

LARGE HUBS

Hub	Airport	CBD	Distance (mi.) Maj. Rt.	Distance (mi.) Alt. Rt.	Descrip. of Maj. Rt. Miles	Av. Travel Time (min.) Maj. Rt. Peak	Av. Travel Time (min.) Maj. Rt. Off-Pk.	Av. Travel Time (min.) Alt. Rt. Peak	Av. Travel Time (min.) Alt. Rt. Off-Pk.	Travel Speed (mph) Maj. Rt. Peak	Travel Speed (mph) Maj. Rt. Off-Pk.	Travel Speed (mph) Alt. Rt. Peak	Travel Speed (mph) Alt. Rt. Off-Pk.	Public Transp.	Comments	Field Evaluation of Current Cond.	Actions Initiated
Detroit/ Ann Arbor, Mich.	Willow Run	Ann Arbor	12.8	-	I: 5.3 FAP: 7.5	22.0	22.0	-	-	35.0	35.0	-	-	Bus	No noticeable delays.		
Houston, Tex.	William P. Hobby	Houston	9.7	10.1	I: 6.3 Other: 3.4	24.0	15.0	28.0	17.0	24.2	38.8	21.6	35.6	Taxi Limo. Bus	Congestion in CBD streets during peak periods.	Good	
Houston, Tex.	Jetero Int'l.	Houston	17.9	18.0	I: 13.0 Other: 4.9	24.0	22.0	26.0	25.0	44.8	48.9	41.6	43.2	None	Airport has not opened yet.		
Kansas City, Mo.	Kansas City Municipal	Kansas City, Mo.	1.3	-	Other: 1.3	7.0	7.0	-	-	11.0	11.0	-	-	Taxi Limo. Bus	No significant delays other than traffic signals.	Acceptable	None. This airport is being phased out.
Kansas City, Mo.	Kansas City Int'l.	Kansas City, Mo.	19.2	-	I: 17.0 Other: 2.2	25.0	25.0	-	-	46.0	46.0	-	-	None. Airport will open in 1970	Mass transit needs for the airport are under study.		
Las Vegas, Nev.	McCarran Field, Las Vegas	Las Vegas	6.7	-	FAP: 2.0 FAS: 4.7	20.0	18.0	-	-	20.0	22.3	-	-	Taxi Limo.			
Los Angeles/ Burbank/ Long Beach, Calif.	Los Angeles Int'l.	Los Angeles CBD	15.0	17.0	I: 5.5 FAP: 1.7 Other: 7.8	40.0	-	-	22.0	22.5	-	-	46.4	Taxi Limo. Bus & Heli- copter under study	Congestion and delays occur at interchanges, weaving between on and off ramps and at traffic signals. Proposals for rail transp. from CBD to airport under consideration.	Congestion is heavy during peak hours in and around the airport. Traffic backs up at frwy. ramps.	Widening of hwy. not in the FA system is planned by the State.
Los Angeles/ Burbank/ Long Beach, Calif.	Los Angeles Int'l.	Long Beach CBD	22.0	-	I: FAP: Other:	44.0	26.0	-	-	30.0	51.0	-	-	Taxi Limo. Bus	Traffic delays in the Long Beach CBD off the F.A. system. Also at the Long Beach - San Diego Freeway Interchange.	Congestion is heavy during peak hours in and around the airport.	

(cm 6-18-68)

HIGHWAY ACCESS TO AIRPORTS

LARGE HUBS

Hub	Airport	CBD	Distance (mi.) Maj. Rt.	Distance (mi.) Alt. Rt.	Descrip. of Maj. Rt: Miles	Av. Travel Time (min.) Maj. Rt. Peak	Av. Travel Time (min.) Maj. Rt. Off-Pk.	Av. Travel Time (min.) Alt. Rt. Peak	Av. Travel Time (min.) Alt. Rt. Off-Pk.	Travel Speed (mph) Maj. Rt. Peak	Travel Speed (mph) Maj. Rt. Off-Pk.	Travel Speed (mph) Alt. Rt. Peak	Travel Speed (mph) Alt. Rt. Off-Pk.	Public Transp.	Comments	Field Evaluation of Current Cond.	Actions Initiated
Los Angeles/ Burbank/ Long Beach, Calif.	Los Angeles Int'l.	Van Nuys CBD	20.0	-	I: 15.5 Other: 4.5	60.0	26.0	-	-	20.0	46.0	-	-		Traffic delays are caused due to signals during the peak periods. Delays along Victory Blvd. and Sepulveda Blvd.		
Los Angeles/ Burbank/ Long Beach, Calif.	Los Angeles Int'l.	Westwood/ Beverly Hills CBD	12.0	-	I: 5.2 FAP: 3.3 Other: 3.5	35.0	25.0	-	-	20.5	29.0	-	-	Taxi Bus	Most of delays are due to congestion and traffic signals on Santa Monica Blvd. (FAP 83) and Sepulveda Blvd.		
Los Angeles/ Burbank/ Long Beach, Calif.	Hollywood/ Burbank Airport	Van Nuys CBD	6.0	-	Other: 6.0	18.0	15.0	-	-	20.0	24.0	-	-	Taxi Bus - involves transfers, indirect trip	Delays in Van Nuys CBD on major intersections.		
Los Angeles/ Burbank/ Long Beach, Calif.	Long Beach Municipal	Long Beach CBD	10.0	-	I: FAP: Other:	26.0	12.0	-	-	23.0	50.0	-	-	Taxi Limo.* Bus* *Limited	Most of delays at local streets in the Long Beach CBD and at the Long Beach - San Diego Freeway interchange, during peak periods.		
Miami/ Ft. Lauderdale, Fla.	Miami Int'l.	Coral Gables	4.3	-	Other: 4.3	14.0	11.0	-	-	18.4	23.4	-	-	Taxi Limo.	Miami Urban Area Transportation Study has been analyzing transportation needs to the airport.		
Miami/ Ft. Lauderdale, Fla.	Miami Int'l.	Miami	7.4	7.4	Other: 7.4	24.0	21.0	26.0	24.0	18.5	21.1	17.0	18.5	Taxi Limo.	Miami Urban Area Transportation Study has been analyzing transportation needs to the airport.		
Miami/ Ft. Lauderdale, Fla.	Miami Int'l.	Miami Beach	11.7	11.0	I: 4.5 FAP: 3.7 Other: 3.5	24.0	21.0	34.0	31.0	29.2	33.4	19.4	21.3	Taxi Limo.	Delays due to weaving on 42nd Ave. near the entrance to the airport. Miami Urban Area Transp. Study has been analyzing transportation needs to the airport.		

HIGHWAY ACCESS TO AIRPORTS

LARGE HUBS

Hub	Airport	CBD	Distance (mi.) Maj. Rt.	Distance (mi.) Alt. Rt.	Descrip. of Maj. Rt. Miles	Av. Travel Time (min.) Maj. Rt. Peak	Av. Travel Time (min.) Maj. Rt. Off-Pk.	Av. Travel Time (min.) Alt. Rt. Peak	Av. Travel Time (min.) Alt. Rt. Off-Pk.	Travel Speed (mph) Maj. Rt. Peak	Travel Speed (mph) Maj. Rt. Off-Pk.	Travel Speed (mph) Alt. Rt. Peak	Travel Speed (mph) Alt. Rt. Off-Pk.	Public Transp.	Comments	Field Evaluation of Current Cond.	Actions Initiated
Miami/ Ft. Lauderdale, Fla.	Miami Int'l.	North Miami Beach	16.4	14.5	I: 7.9 FAP: 7.0 Other: 1.5	31.0	31.0	34.0	31.0	31.8	31.8	25.6	28.0	Taxi Limo.	Delays due to weaving on 42nd Ave. near the entrance to the airport. Miami Urban Area Transp. Study has been analyzing transp. needs to the airport.		
Miami/ Ft. Lauderdale, Fla.	Miami Int'l.	Hialeah/ Miami Springs	2.9	-	FAP: 1.3 Other: 1.6	10.0	10.0	-	-	17.5	17.5	-	-	Taxi Limo.	Miami Urban Area Transportation Study has been analyzing transportation needs to the airport.		
Minneapolis/ St. Paul, Minn.	Minneapolis/ St. Paul Int'l.	St. Paul	8.3	-	FAP: 3.5 Other: 4.8	17.0	16.0	-	-	29.3	31.2	-	-	Taxi Limo.	No significant delays. Most of the sections are expressway. Alternate routes will be provided with the completion of I-35W in 1971.	Good	No action to add any sections to F.A. system. Current budgeting includes funds to improve non F.A. section to Expwy.
Minneapolis/ St. Paul, Minn.	Minneapolis/ St. Paul Int'l.	Minneapolis	12.3	-	I: 5.8 FAP: 6.5	21.0	18.0	-	-	35.2	41.0	-	-	Taxi Limo.	No significant delays. All the route is on expressways. Alternate route will be provided with the completion of improvements to expressway standards of TH 55.	Good	No action. The route is on the F.A. system.
New Orleans, La.	Moisant, New Orleans Int'l.	New Orleans	14.4	14.7	I: 9.4 FAP: 4.0 Other: 1.0	30.0	23.0	34.5	31.0	28.6	37.4	25.4	28.3	Taxi Limo. Bus	Most of delays are caused from traffic signals at major intersections. Completion of I-10 beyond the airport will improve travel to airport.	No real access problem exists.	Consideration is given to proposed HUD demo. project to use exist. R.R. tracks for rail transit.

HIGHWAY ACCESS TO AIRPORTS

LARGE HUBS

Hub	Airport	CBD	Distance (mi.) Maj. Rt.	Distance (mi.) Alt. Rt.	Descrip. of Maj. Rt. Miles	Av. Travel Time (min.) Maj. Rt. Peak	Av. Travel Time (min.) Maj. Rt. Off-Pk.	Av. Travel Time (min.) Alt. Rt. Peak	Av. Travel Time (min.) Alt. Rt. Off-Pk.	Travel Speed (mph) Maj. Rt. Peak	Travel Speed (mph) Maj. Rt. Off-Pk.	Travel Speed (mph) Alt. Rt. Peak	Travel Speed (mph) Alt. Rt. Off-Pk.	Public Transp.	Comments	Field Evaluation of Current Cond.	Actions Initiated
New York, N.Y./ Newark, N.J.	Kennedy Int'l.	Manhattan	14.3	13.2	I: 7.0 FAP: 7.3	50.0	30.1	68.5	54.8	17.2	28.5	11.5	14.5	Taxi, Airport Coach, Subway, Bus, Helicopter	Most of delays are because of inadequate ramp connections, heavy weaving, left hand exits, unbalanced lanes, overloaded highways. Planned improvements to expressways might improve travel to some extent.		Several types of improvements are suggested, including a TOPICS type approach, ramp metering, etc.
New York, N.Y./ Newark, N.J.	La Guardia	Manhattan	7.8	10.7	I: 6.8 FAP: 1.0	31.5	19.1	34.0	23.6	14.9	24.4	18.9	27.2	Taxi, Airport Coach, Subway, Bus, Helicopter	Delays are due to outmoded designs of expressways, frequent ramps, construction and inadequate weaving distances. Planned improvements should alleviate most delays.		Same as Kennedy Int'l. Airport.
New York, N.Y./ Newark, N.J.	Newark	Manhattan	11.0	13.5	I: 10.4 Other: 0.6	23.7	15.9	48.9	24.2	27.8	41.5	16.6	33.5	Taxi, Airport Coach, Bus, Helicopter	Delays are due to weaving, lane drops, and indirect connections from Lincoln Tunnel to airlines terminal.		
Philadelphia, Pa./ Camden, N.J.	Philadelphia Int'l.	Philadelphia, Pa.	8.9	7.7	I: 4.1 FAP: 4.8	24.0	20.0	26.0	21.0	22.0	27.7	17.8	22.0	Taxi Limo. Bus	Major delays are due to congestion of intersection of 26th St. and Penrose Ave., and due to narrow Penrose bridge. Several improvements recommended. Completion of Interstate will eliminate most delays.	Reasonable level of service.	
Philadelphia, Pa./ Camden, N.J.	Philadelphia Int'l.	Trenton, N.J.	41.5	50.1	FAP: 37.3 Other: 3.2	76.0	-	73.0	-	33.0	-	40.0	-	Taxi Limo. Bus	Delays due to at-grade intersections. Route through highly urbanized areas. Extension of I-295 will improve travel times.		
Philadelphia, Pa./ Camden, N.J.	Philadelphia Int'l.	Camden, N.J.	12.4	12.5	I: 5.1 FAP: 5.3 Other: 2.0	30.0	27.0	33.0	29.0	24.8	27.6	21.7	25.8	Taxi Limo. Bus	Delays are due to CBD congestion in Camden, frequent traffic signals on part of the route; however, this section is scheduled for improvement to expressway.		

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Philadelphia, Pa./ Camden, N.J.	Philadelphia Int'l.	Wilmington, Del.	19.8	-	?	52.0	-	-	-	23.0	-	-	-	Taxi Limo.	Delays are caused due to congestion from local traffic (industrial plants, etc.) along the route. Poor highway lighting.		
Pittsburgh, Pa.	Greater Pittsburgh	Pittsburgh	17.0	-	I: ? Pkwy: ?	No travel times given.				About 50 mph. during peak periods.				Taxi Limo.	Completion of the Interstate system and other scheduled improvements will provide better access to airport.		
San Francisco, Calif.	San Francisco Int'l.	San Francisco	14.5	-	I: 13.0 Other: 1.5	35.0	23.0	-	-	25.0	38.0	-	-	Taxi, Airport Bus, Comm. Bus Helicopter	Airport circulation during heavy demand periods gets congested. Traffic backs up on freeway ramps. Proposals for rail rapid and express bus systems under consideration.	Wilbur Smith is preparing report with recommendations.	
San Francisco, Calif.	San Francisco Int'l.	Oakland	25.5	-	I: 20.5 FAP: 3.0 Other: 2.0	55.0	36.0	-	-	28.0	42.5	-	-	Taxi, Airport Bus, Comm. Bus	Same as for San Francisco CBD.	Wilbur Smith is preparing report with recommendations.	
San Francisco, Calif.	San Francisco Int'l.	San Jose	34.5	-	I: 30.5 FAS: 3.0 Other: 1.0	49.0	40.0	-	-	42.0	52.0	-	-	Taxi	Same as for San Francisco CBD.	Wilbur Smith is preparing report with recommendations.	
San Francisco, Calif.	Metro. Oakland Int'l.	Oakland	10.0	-	FAP: 6.5 Other: 3.5	20.0	15.0	-	-	30.0	40.0	-	-	Taxi, Airport Bus, Helicopter	Both San Francisco and Oakland airports will be serviced directly by the "bayfront" freeways. BARTD station (3 mi. from airport) will be connected by shuttle service.		
San Francisco, Calif.	Metro. Oakland Int'l.	San Francisco	20.0	-	I: 10.0 FAP: 6.5 Other: 3.5	40.0	31.0	-	-	30.0	39.0	-	-	Taxi, Airport Bus, Helicopter	Same as for Oakland CBD.		
San Francised, Calif.	Metro. Oakland Int'l.	San Jose	36.0	-	I: 9.5 FAP: 24.0 FAS: 1.5 Other: 1.0	61.0	41.0	-	-	35.5	53.0	-	-	Taxi			

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San Francisco, Calif.	San Jose Municipal	San Jose	3.5	-	FAP: 2.0 FAS: 1.5	8.0	7.0	-	-	26.5	30.0	-	-	Taxi	This airport handles less than 10% of the total hub air traffic.		
Seattle/ Tacoma, Wash.	Seattle/ Tacoma Airport	Seattle	14.0	13.0	I: ? FAP: ? Other: ?	22.0	20.0	24.0	17.0	38.0	42.0	32.5	45.8	Taxi Limo. Bus Heli-copter	Study is made to enlarge airport facilities and improve access for future traffic.	Service adequate	
Seattle/ Tacoma, Wash.	Seattle/ Tacoma Airport	Tacoma	22.0	20.0	I: ? FAP: ? Other: ?	35.0	33.0	43.0	36.0	38.0	40.0	28.0	33.4	Taxi Limo. Bus	Same as Seattle CBD.	Service adequate	
St. Louis, Mo.	Lambert St. Louis Municipal	St. Louis	14.8	26.8	I: 13.7 Other: 1.1	25.5	21.0	46.0	37.5	35.0	42.2	33.6	41.2	Taxi Limo. Bus	Delays on the I portion of route occur due to lane drops. The airport interchange movements are heavy. Reconstr. of this interchange is being planned. State and BPR approval is required.		Airport commission is undertaking continuous study of airport roadways and parking needs.
Washington, D.C.	National	Washington	4.0	-	I: 0.5 FAP: 1.7 Other: 1.8	17.0	13.0	-	-	14.0	18.5	-	-	Taxi Limo. Bus	Delays occur on CBD streets. Proposed rail rapid transit will provide a station in the vicinity of airport.		
Washington, D.C.	National	Alexandria, Va.	3.5	-	FAP: 0.9 Other: 2.6	12.0	8.0	-	-	17.5	26.2	-	-	Taxi Bus	Delays occur on CBD streets.		
Washington, D.C.	National	Rosslyn, Va.	4.0	-	Other: 4.0	8.0	7.0	-	-	30.0	34.0	-	-	Taxi Limo.			
Washington, D.C.	National	Bethesda, Md.	10.1	-	FAP: 6.0 Other: 4.0	25.0	20.0	-	-	24.2	30.3	-	-	Taxi Limo. Bus	Delays occur on CBD streets. Proposed rail rapid transit will provide a station in the vicinity of the airport.		

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Washington, D.C.	National	Silver Spring, Md.	10.2	10.9	I: 0.5 FAP: 7.9 Other: 1.8	36.0	30.0	16.0	16.0	17.0	20.4	41.0	41.0	Taxi Limo. Bus	Delays occur on most of the route as local arterials are used. Alternate route is on proposed I system. Proposed rail rapid system will improve access.		
Washington, D.C.	Dulles Int'l.	Washington	24.8	27.0	FAP: 6.3 Other: 4.6 Airp. Access 13.9	52.0	39.0	50.0	39.0	28.6	38.2	32.4	41.5	Taxi Bus Limo.	Delays due to heavy congestion around CBD. Also delays during peak periods on connections between I-495 and I-66 and on Key Bridge. Completion of I-66 will improve access. Proposed rail rapid could be extended about 3 miles to serve airport.		
Washington, D.C.	Dulles Int'l.	Rosslyn, Va.	22.4	23.6	FAP: 4.0 Other: 4.6 Airp. Access 13.8	40.0	31.0	22.0	22.0	33.6	43.4	64.0	64.0	Taxi Limo. Bus	Completion of I-66 will improve access to airport. Trip will be completely on freeways.		
Washington, D.C.	Dulles Int'l.	Bethesda, Md.	25.3	-	I: 9.7 FAP: 2.3 Airp. Access 13.3	36.0	31.0	-	-	42.2	49.0	-	-	Taxi Limo.	Proposed addition of lanes on I-495 will improve travel to airport.		
Washington, D.C.	Dulles Int'l.	Silver Spring, Md.	30.5	-	I: 13.3 FAP: 1.9 Airp. Access 13.3	43.0	36.0	-	-	40.0	47.5	-	-	Taxi Limo.	Proposed addition of lanes on I-495 will improve travel to airport.		
Washington, D.C.	Friendship Int'l.	Washington	32.0	-	FAP: 8.2 Other 23.8	51.5	51.5	-	-	37.2	37.2	-	-	Taxi Limo. Bus	Delays in D.C. CBD due to congestion. Authorized improvements on the parkway (other) will reduce travel time. Completion of I-95 in D.C. & Md. will improve travel times even more.		

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MBTA & Mass. Port Authority.
Study of improved high-speed
public transportation be-
tween Logan & Downtown Bos-
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